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INTERNAL COMBUSTION ENGINED SUBMARINE CHASERS

25 CENTS

# MOTORSHIP

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*In the Interests of Commercial Motor Vessels*

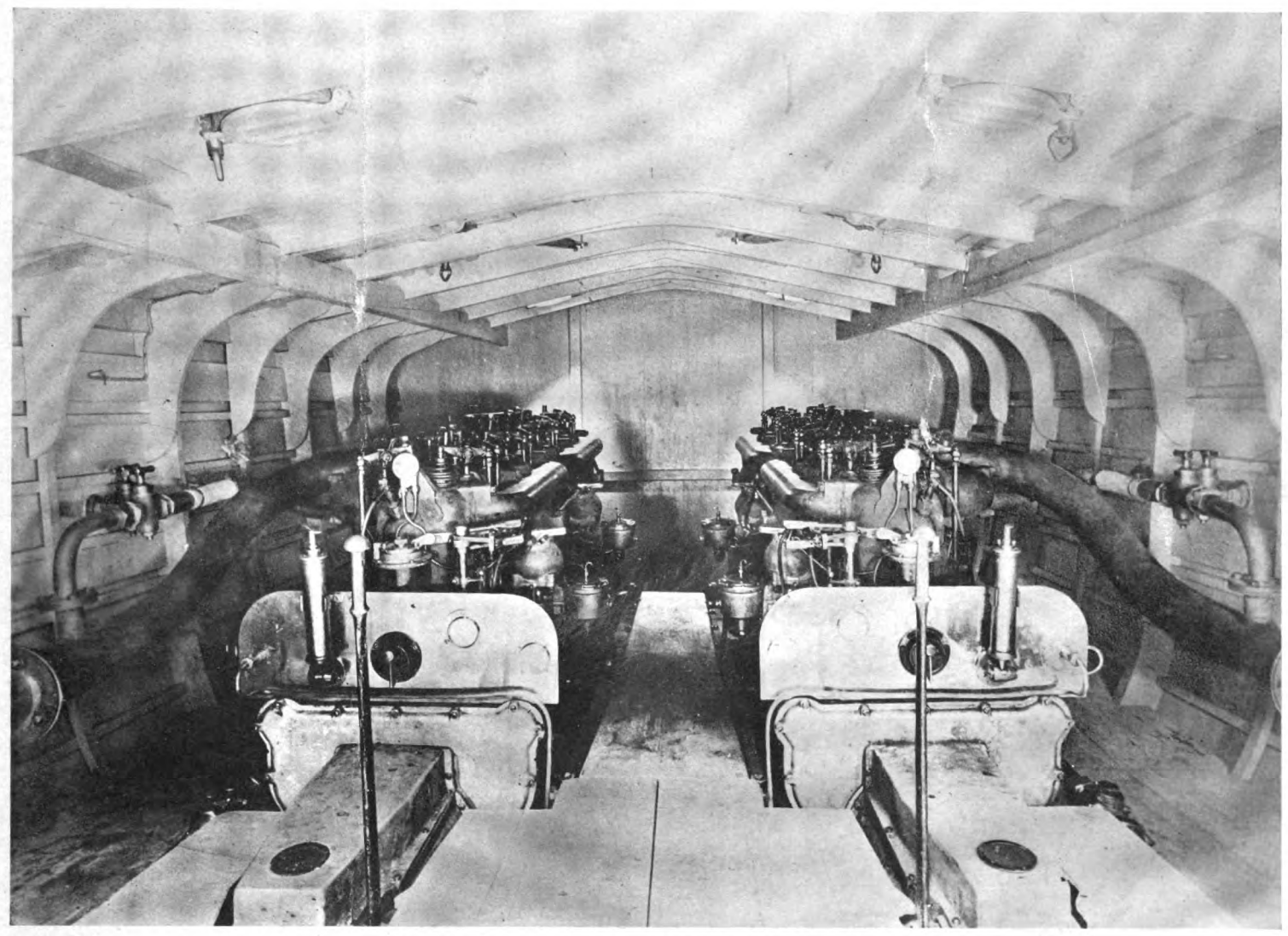
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SEATTLE

NEW YORK



AMERICAN ENGINES IN ITALIAN SUBMARINE CHASERS

The Engine Room of an Italian Submarine Destroyer, Showing Her Two Model R, 250 H. P. Sterling Engines



## Motor Craft as Submarine Destroyers and Patrol Boats

WHAT Europe would have done without the thousands of motor-craft, now in the services of the various Allied navies undertaking a hundred and one important duties, is hard to say; but there is no doubt that the United States must build motorboats by the hundreds and even thousands—boats of 50 ft., 60 ft., 70 ft., 80 ft., 90 ft., 110 ft., and so on up to 150 ft., for there is work for all sizes, each class being as important as any other in its respective duties. These patrols and submarine chasers are principally in the interests of shipping; therefore, it is the profound duty of all American shipowning companies to set aside some of the enormous profits now being made and each build one, or more, patrol craft and present or loan them to the U. S. Government. Let there be no slackers!

The Navy needs more boats than it can secure in batches, and there are many small boat builders about the country who can accept orders for one, two, or three craft, who will not now receive orders from the Navy Department, which at present is obliged to devote its energies and attention to boatyards that can turn out these chasers and patrol-boats by the dozen. Who will be the first shipowner to show true patriotism? Flag waving is all right in its way, but action is better. Let shipowners remember that without patrol-boats the submarine would become such a menace that shipping would be rendered unprofitable. Almost daily reports are published about the huge increase of profits made by the various American shipping companies, and it is time that the president of every such company announced that his co-directors have decided to immediately build so many submarine chasers, or patrol-boats and offer them to the Navy.

Among the firms who can accept orders for prompt delivery of the high-powered machinery of such boats is the Sterling Engine Co. of Buffalo, N. Y., who have supplied motors now driving units of the Russian and Italian mosquito fleets, and details of their engine is given elsewhere. Many of the U. S. Volunteer Naval Reserve patrol-boats, such as the "Chingachgook," "Lynx," and "Boy Scout," also are driven by Sterling gasoline motors.

We give some very interesting illustrations of a number of patrol-boats built in Italy and installed with Sterling motors, and which in design are quite different from the chasers of other countries. Built for Adriatic and Mediterranean waters, they are not unlike many of the motorboats



FLEET OF ITALIAN CHASERS ON WHICH GUNS ARE BEING MOUNTED AT GENOA.  
The Mother Ship in the Background Is Diesel Driven.

that raced at Monaco previous to the war, indicating the great value of motorboat racing as a developer of naval motor-craft. In fact, in profile these particular boats are not unlike the B. I. Trophy racer, "Maple Leaf III," which was built in England by Thornycrofts. We refer to the hull design only. As the Thornycroft atmosphere always has been prevalent in some of the Italian shipyards this element is not surprising.

During the time the engineer—M. Flaherty—from the Sterling works was in Italy supervising the installations, the boats that were in service were operating day and night, and although he heard rumors of the effective work they were doing, no circumstances came within immediate recognition. These same boats, however, have since captured or sunk in the Adriatic Sea, near Trieste, some 20 submarines, and are lately reported to have dropped a torpedo, sinking a

heavily-armed Austrian transport with its full complement of soldiers.

The boats were built by Ansaldo & Co. of Genoa and are 58' long and 9' beam, are equipped with two 6.5 m. m. Colt automatic rifles (Browning patent) capable of firing 250 shots a minute, and one 47 m. m. anti-aerial gun. Unlike the American type destroyers, the Italians have a curved bow and comparatively little freeboard, termed the bullet nose type—the idea being to insure firing at an object closer to the bow of the boat. Submarines are not readily discernible, but are easily seen from a balloon or aeroplane. The immediate vicinity, however, is determined by the rapidly rising bubbles, which emanate from every U-boat running under the surface.

There are many processes of destruction peculiar to each government, a number of which have been kept secret. The Italian Navy, for instance, has had a secret (lately given to her allies) involving a torpedo which is towed from stern of one of these boats and which will submerge at a rate, proportionate to the speed of the boat, with the intent of its hitting the submarine. The average depth to which a submarine submerges is probably not over 150 feet, although the record is 320 feet, so, generally speaking, the system is feasible. U-boats of the type being rapidly constructed by the German Government are approximately 275 to 300 feet in length, and although immensely practical, it is within the province of the various classes of destroyers to exterminate them.

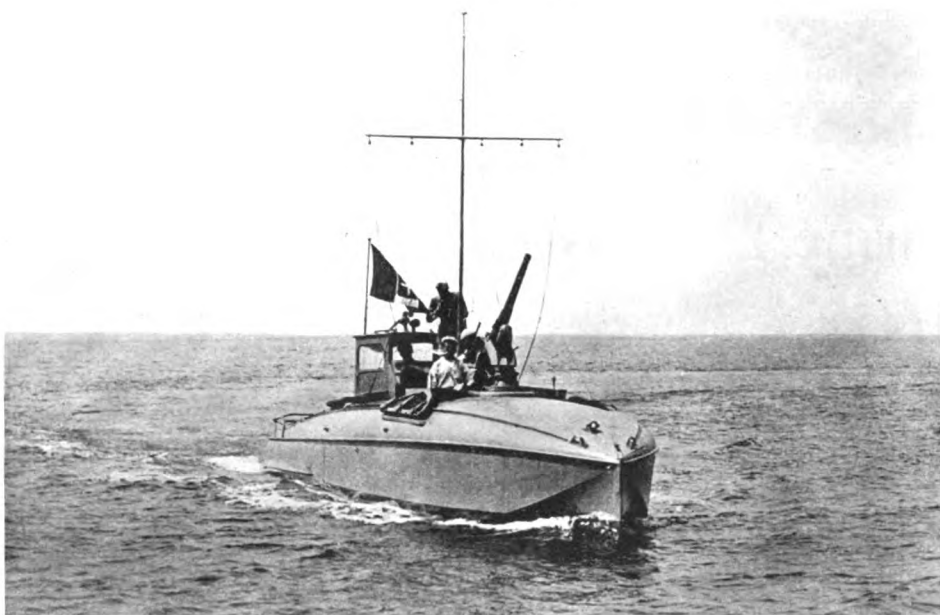
The engines that are installed are similar in design to those described elsewhere in this issue of Motorship, and are eight-cylinder Sterling valve-in-the-head motors each of 180-200 h. p., two being fitted per boat. Every care was taken to familiarize the ex-plo boys, bakers, and shoemakers in Italy with the design. For this purpose a school was established, and a Sterling engine was sawed in half longitudinally, and every working part was carefully explained to the students. After ten days' instructions these boys were turned over to the Sterling engineer in charge, who taught them how to run the boats, and most of them became very efficient. From report several of these boys afterwards performed very heroic deeds, and some were killed in action, several of the boats being smashed up or badly battered in combat with the Austrian submarines.

One of the boats, it will be noticed, is a little different in design from the other boats, being of the displacement type, and this craft will be



ITALIAN DESTROYERS AND THEIR MOTHER SHIP

These little "wasps" recall the Monaco racing craft of previous years. They are said to be almost indistinguishable through a periscope



BOW VIEW ITALIAN CHASER SHOWING PARTIAL ELEVATION OF ANTI-AERIAL GUN

seen in the center of the group of boats. She was equipped with two engines each of 250 h. p., and the engine-room photograph, reproduced upon the cover of this issue, shows the interior of this particular boat.

Now at the Sterling Engine Company's works is Captain Goode, late of the British army, who has seen actual service, and at a recent banquet given by the Bowling Club of the Sterling Engine Co. he gave some interesting data regarding the chasing and sinking of submarines in British waters. "There are boats daily combing the North Sea for submarines. Overhead a dirigible of the Blimp type soars, steadily zigzagging along a prescribed territory. Suddenly 'Fritz' is sighted—quickly the wireless operator in the Blimp flashes a message to the pair of chasers—directing their operations towards the submarine—'Fritz' is a wary craft, and with his boat adorned in alternate shades of blue and violet, covered with the mosses and barnacles of the sea, he is a hard proposition to discern. The little chasers, gathering speed, proceed along the course taken by the submarine and, when in his immediate vicinity, drop between them a copper wire net. Dragging this along back of them, they rapidly overtake the submarine, and the blades of the propeller, catching in the mesh of the copper net, quickly bring 'Fritz' to a standstill. Immediately the captain of the U-boat starts to rise. As soon as his periscope clears the surface of the water a steady stream of shots in lightning rapidity emanates from the guns of the chaser and the eye of the periscope disappears.

"Blinded, 'Fritz' still continues to rise, and as the front deck of the submarine comes out of the

water, a hatch crashes open, and a 4.5 gun comes into view. It then becomes a question of which



ITALIAN DESTROYER. NOTE CLEAN LEVEL RUNNING AT HIGH SPEED. THE DAVIT ON THE STERN IS USED FOR LOWERING MINES OR BOMBS. THE BOW GUN IS A 47 M. M. ANTI-AERIAL GUN. THE EQUIPMENT ALSO INCLUDES RAPID-FIRE GUNS



"LYNX" NO. 9, VOLUNTEER POWER BOAT ASSOCIATION, NATHANIEL AYER JR. (OWNER), EQUIPPED WITH 6-CYLINDER STERLING

is the quicker shot. If the little chaser gets in the first wallop of her gun, the submarine is finished, but once they train their 4.5's on the destroyer, they smash those boats up like match boxes. Sometimes 'Fritz's' compressors are not working properly and there is insufficient air to force the water from the compartments; in that case he has to lie below the surface of the water until a trawler comes along, which raises him and makes crew and boat captives, providing the crew is still alive. Sometimes they are under water for three days, held there by the destroyers to avoid a surface battle, at the expiration of which the trawler raises them, dumps out the crew and tows the submarine into port." (We also had this particular information from another British officer.—Ed.)

"In one harbor during 1916 eighty-six captive submarines were observed, heavily guarded, and although it would seem that at the rate of destruction and capture of these craft, the German Navy would rapidly become depleted of its U-boats, it has lately been reported that the Germans are able to construct new submarines at a faster rate than they are destroyed. The general idea of the British anent this submarine war is, that it is a rotten business and they would like to get it over with quickly; that it is a detestable thing, to be endured, and if we had the assistance of America they undoubtedly could end it."

In Italy quite a different system has been adopted, the boats in use being smaller than those

in the service of the British Navy, and generally speaking, the water is much calmer, as will be noticed from the illustrations. There is in use a type of bomb, greatly resembling a pail, about 16" in diameter, 18" high, containing about 100 pounds of high explosives—T. N. T.—or ballinite. These bombs, sinking until the pressure at a certain depth causes a contact, explode with such a concussion as to render ineffective the chemicals of the submarine's batteries in a radius of 150 yards. Now if the submarine has her batteries destroyed, her electric motors cannot run, she is compelled to expel the water from her compartments by air pressure and rise by virtual buoyancy to the surface in order to use her Diesel engines.

These patrol-boats are capable, by reason of their shallow draft, of traveling completely over a mine field, which is planted below the surface. With a certain appliance they reach down and cut the mine ropes, and as the mine floats to the surface, it is either taken in tow and planted at a point disadvantageous to the enemy, or is destroyed. One method of destruction in connection with the aeroplane or balloon service, is for the destroyers to rush in a bunch to the spot the submarine was last seen to sink, spreading out star-shaped, they continue to run and when the submarine comes to the surface, she must be between two of them, where, guided by the aeroplane or balloon, it is a simple matter for the chaser to run them down.

The Sterling Engine Co. also has supplied the machinery for a number of boats which have been built at Greenport, Long Island, for Russia, for use in the Black Sea.

## GASOLINE ENGINES FOR PATROL BOATS.

ONE of the greatest difficulties that confronted the Navy Department when it set about the task of ordering submarine chasers was that of obtaining suitable engines in short time. For the first batch of 110-footers the naval experts decided that comparatively slow speed motors of high-power were required, and, apparently the only concern that could rapidly construct such sets were the Standard Motor Construction Co., who previously had built about 1,100 engines of 250 b. h. p. for the 76 and 86 footers supplied to Great Britain. So, for the first batch of boats the Navy will supply the Standard motors as rapidly as the 110-footers can be turned out by various builders, three engines to be installed in each boat. It is obvious that this "standardization" arrangement would result in quicker deliveries than if each builder made his own arrangements for obtaining machinery. Also repairs will be able to be made in very short time, duplication of parts thereby being greatly facilitated.

When the initial batches of 110-footers are completed a large number of smaller vessels will be needed, and possibly engines of higher speed and lighter weight may be used, such as are built by dozens of domestic companies for motor-yachts. In many instances these smaller boats, namely, 60, 70, 80, 90 and 100-footers, will be needed to replace some of the yachts now undertaking harbor, sound, estuary, and bay, patrols, for many of these yachts will need thorough overhauls and even "scrapping" after six or eight months service.

Generally speaking the average yacht is run under actual power for more than 650 hours each season, so that the patrol craft may get the same amount of running in a month or six weeks, and will have to operate under weather conditions that in peace times would cause most yachts to stay in harbor. Hence, it will be understood why many yachts have their limitations for patrol duties.

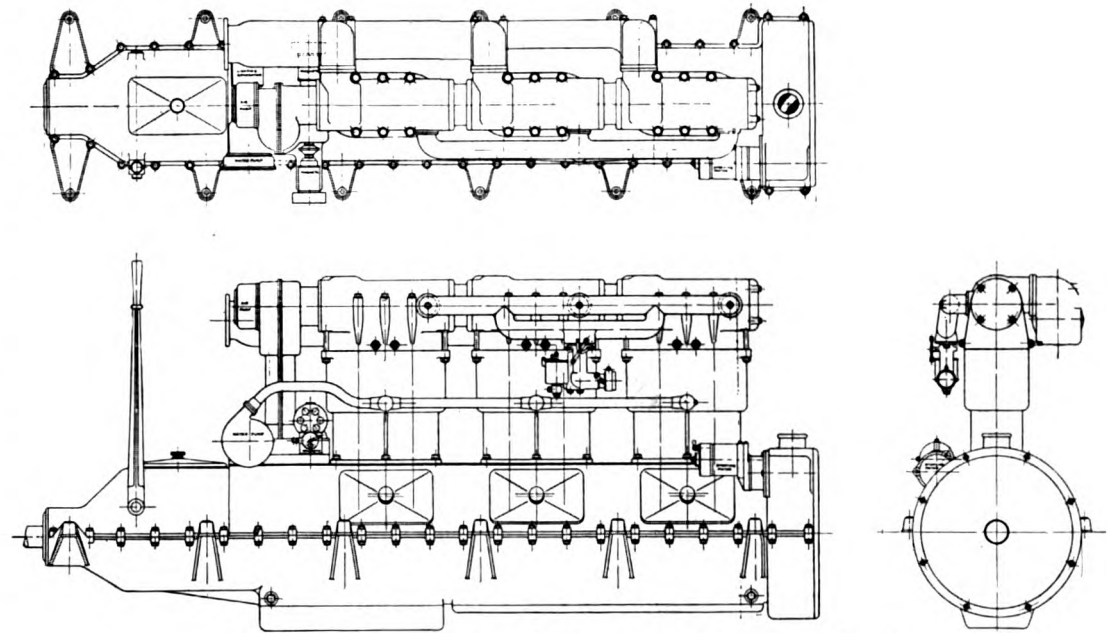
## The Sterling Engine.

Among domestic engine-builders who claim that they manufacture marine motors suitable for patrol-boats and submarine-chasers may be mentioned the Sterling Engine Co., of Buffalo, N. Y. They put forward as an ideal motor for the purpose, their 300 h. p. heavy-duty speed engine, which develops 240 b. h. p. at 800 r. p. m., and 300 b. h. p. at 1,000 r. p. m. from eight cylinders  $6\frac{3}{4}$ " bore by 9" stroke. They also claim that this motor absolutely will operate continuously at their maximum revolutions. Also that two of these engines installed as a twin-screw outfit, provided the design of the boat will permit, ought to drive her at 20 knots. The Sterling Co. further point out that "due to the short length of these boats in conjunction with their high-speed they could not be touched by a torpedo, having ability to maneuver quickly." "Boats of this type will perform the same service as rendered by the larger destroyers." "It has lately been demonstrated that the installation of torpedo-tubes is practical." "Imagine a 110-footer setting low in the water, running about 20 knots, with a captain of sufficient daring to attack a large battleship, and you have an idea of what such boats are actually capable of." "We have positive information that some boats operating with Sterling engines in foreign governments have sunk large transports, and the destroyer was only 58' long."

As yet they have not secured any business direct from the Government for these 300 h. p. motors, although Motorship understands that a number have been installed in privately owned yachts that are now engaged in patrol work.

While at a glance the general appearance of the Sterling 300 h. p. engine will seem much like that of other eight-cylinder gasoline machines of the heavy-duty type, a closer examination will reveal differences in nearly every department. Many of the features of this engine are novel and a departure from the usual, due to the fact that the cost would be prohibitive for use on the ordinary motor. The testing is the most rigorous and severe and is not confined to the engine as a whole, but before it is accepted, each piece is carefully tested while the engine is in the course of construction.

The weight is from 5,000 to 5,600 pounds, according to the individual requirements. When extreme lightness is an important factor, the lower base is built of aero-metal of finest quality. This base runs the entire length of engine and forms a support for the clutch and reverse gear, the thrust bearings, and the upper portion of engine. Particular attention should be called to the upper base. It is made of manganese bronze, of a special "A" frame construction

THE DRIGGS SIX-CYLINDER  $6\frac{3}{4} \times 8\frac{1}{2}$  SILENT VALVE MARINE MOTOR

(patent allowed) affording a far greater strength and rigidity than is possible with the usually constructed base which divides the crank-shaft center line.

The valve system is noteworthy, consisting as it does of a double set of exhaust and inlet valves throughout; that is, there are two inlet-valves and two exhaust-valves to each cylinder. This insures an instantaneous inlet of fresh vapor and a more complete scavenging of the exhaust gases than is possible to obtain with the single valve system. Furthermore, the valves do not require frequent grinding, as would be necessary with the larger single valves. All valves are made of tungsten steel. Ignition is by means of two independent systems, making this important feature absolutely certain and reliable. A complete electric starting and charging system is included as a part of the regular equipment of this engine.

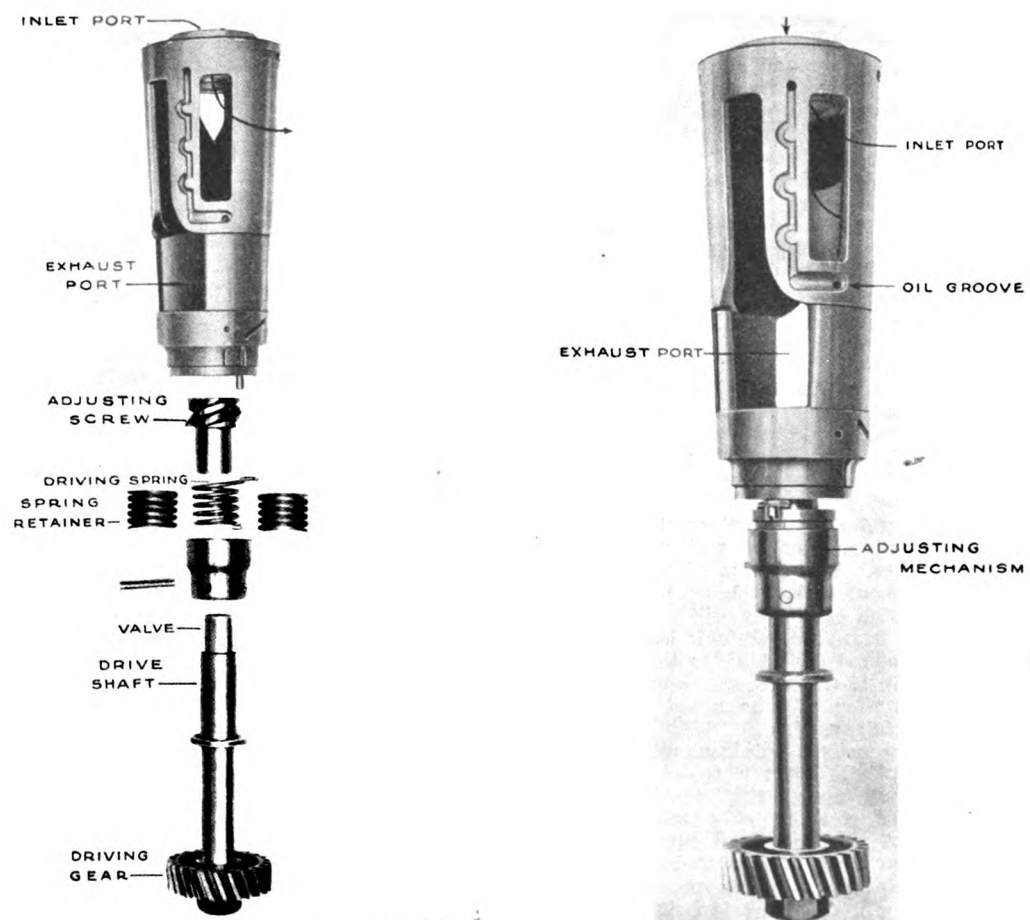
## The Driggs Engine.

Another engine that could be used in this class of boat is the Driggs silent-valve motor, and the drawings show the six-cylinder  $6\frac{3}{4}$ " by  $8\frac{1}{2}$ " model which is conservatively rated at 200 horse-power at 1,000 r. p. m., but which will deliver about 250 b. h. p. at 1,200 r. p. m., on a weight of 2,400-2,500 lbs. The makers, the Driggs Ordnance Co., are figuring building an eight-cylinder model of simi-

lar cylinder dimensions which will deliver 275-300 b. h. p. at 1,000 r. p. m. They propose three engines of either size for the 110 ft. boat, and state that nothing will be gained by lower speed motors when it is possible to obtain sufficient strength and durability at higher speeds, and that the electric system of starting is more simple and satisfactory, whereas the use of air starting complicates the installation.

In design the Driggs engine differs from that of any other marine motor, poppet valves being substituted by tapering rotary valves. In the past, many efforts have been made to produce gas engines with rotary valves, since it has been generally conceded by engineers that valves of this character, if practically applied, would greatly increase the volumetric efficiency of internal-combustion-engines, and the elimination of many moving and reciprocating parts would lead to higher mechanical efficiency and silent operation. Such efforts have, in the main, resulted in failures, these failures being attributed to the fact that the valves were of necessity called upon to handle the hot exhaust gases, thereby causing the valves to expand and become otherwise distorted, and making them bind and seize in their seats, with consequent damage to themselves.

With the object of overcoming these difficulties,



DETAILS OF TAPERING ROTARY VALVE USED IN DRIGGS MOTORS

valves of this character have been made with clearance to allow for expansion. However the effort to correct the evil of sticking or seizing of such valves has resulted in introducing another difficulty of equal seriousness, since the clearance referred to, made the starting of engines with these valves difficult, owing to leakage under compression. The clearance also caused irregular firing and skipping of such engines when running under "low throttle," the same being due to leakage past the valves and valve seat surfaces, and added difficulties in the way of lubrication. In the Russell design as applied to the Driggs engine the difficulties heretofore experienced by engineers in the application of rotary valves to internal-combustion engines are claimed to have been entirely overcome.

The valve-shaft is driven by means of a gear from the time-shaft, and the steep pitch adjusting-screw engages in a thread in the valve, while the valve driving-spring forms the driving connection between the valve driving-shaft and the valve. As the valve heats, it expands, and requires greater effort to drive it. This extra effort causes the valve-shaft to advance angularly a fraction of a degree relative to the valve against the action of the spring. In so doing, the screw tends to screw out of the thread in the valve, and move the valve upward in its tapered seat. The valve lifts only enough to make the driving effort normal. This effort is normal when clearance is such that there is a film of oil of almost infinitesimal thickness between the valve and its seat. The adjusting mechanism controls this accurately so that the oil film is maintained a constant thickness. Thus a valve is produced which is said to be efficient, silent, adjustable and gas tight at all times.

About ten years ago the writer designed a rotary-valve engine, with tapered valves, and a spring adjustment, and submitted to John I. Thornycroft & Co., of London, in whose marine motor shops he was then engaged; but the idea was turned down by them as impractical. That old design differed in several ways from that of the Driggs engine, and perhaps was crude and needed developing. Also there were separate valves for the inlet and exhaust, whereas the Driggs engine uses the same valve, for both. I mention the matter merely as one of interest. However, I still believe that had it been developed its practical results would have been produced.

With the Driggs-Russel design the rotating valve permits large intake and exhaust ports and also the immediate opening of both ports to their full capacity. The power stroke is, therefore, held for a longer period and the scavenging of the exhaust gases is more quickly performed and more complete. The result is greater power per unit of cylinder volume. The large ports, unrestricted gas passages and purity of the mixture due to the thorough scavenging give greater efficiency and economy of operation. Three silent valves control the inlet and exhaust functions for a six-cylinder engine and provide port areas many times greater than those of poppet valve engines.

#### STEAM-DRIVEN SUBMARINE CHASER FLOTILLA.

FOUR steam-driven submarine-chasers now are under construction at the Herreshoff yard to the order of three well-known millionaires, namely, Messrs. Harold Vanderbilt, Payne Whitney, Robert E. Tod, and Alfred I. du Pont, who will place them at the disposal of the Navy Department when they are completed, which will be in several months time. Built of steel, they will be 110 ft. long, and will have a speed (guaranteed) of 27 knots, the propelling power being furnished by steam-engines, and oil-fired boilers of 1,500 i. h. p. per boat. The complement will consist of 20 officers and men. The radius of action is said to be 650 miles at full-speed, or 1,500 miles at 15 knots, in which case they will need a bunker capacity of 133 barrels of oil-fuel; because if full speed be maintained for 24 hours they will have to be re-fueled. If the above power is accurate the fuel-consumption will be about 19 tons per diem when at full-speed.

There are two general points about these boats that need criticism. First a speed of 27 knots is too high, as it means that considerable seaworthy qualities and cruising radius will be sacrificed in order to obtain an extra percentage of speed that will not be required except under very special circumstances, such as when the superstructure of a submarine is sufficiently damaged to prevent her submerging, in which event she either would run away on the surface

at full-speed, or else put up a square fight with her deck guns. The modern German submarine is fairly heavily armored, and carries guns of large calibre, and would give even an 110-foot chaser quite a good fight if forced to the test, and probably would finish victorious. But, the chasers will have advantage in that they patrol in packs, but occasionally one will become separated from the flotilla, and likely as not would then run across a submarine.

The utilization of steam machinery as propelling power lends itself open to serious doubts, inasmuch, as a submarine will be able to locate a flotilla of such craft fifteen, or more, miles away, even through her periscope, by means of the columns of smoke that will arise from the use of oil-fuel under the boilers, and some means of consuming the smoke will have to be made. The owners of these boats may have done better to have fitted heavy-oil-engines or gasoline-motors even if longer delivery resulted.



Photo by Baker, Boston.

"LYNX" NO. 9, V. P. B., DESIGNED BY SWASEY, BUILT BY THE GEORGE VANDERBILT CORPORATION, POWERED WITH TWO TYPE F SIX-CYLINDER STERLING EXPRESS CRUISER ENGINES

#### THE CALIFORNIA MOTORBOAT PATROL.

Over two hundred motorboats have been offered by California owners for use of the government in the war. Of this number a fair proportion have been inspected by the U. S. Navy inspectors and accepted for service. Over forty boats have actually been enlisted in San Francisco Bay and nine full crews have been organized. It is the intention of the government to give owners who enlist themselves in the Naval Coast Defense Reserve the first preference as commanders of their boats, which feature is attractive. H. S. Crocker, of the Pacific Motor Boat Club has been appointed lieutenant commander in the Naval Coast Defense Reserve, and C. Willard Evans, chairman of the California section of the American Power Boat Association, has been appointed an ensign. Both men are in active service as recruiting officers at 555 Market St., San Francisco.

#### NORWAY-PACIFIC LINE BUILDING NEW MOTORSHIPS.

The Norway-Pacific Line, whose San Francisco offices are in the Merchants' Exchange building, are to have three new motorships built in Europe for use in the Scandinavian-American trade. Two of these vessels will have a tonnage of 10,000, the same as their motorship "George Washington" and will be powered likewise by twin 1550 h. p. Burmeister & Wain full Diesel engines. These two vessels are contracted for building at the shipyards of Burmeister & Wain in Copenhagen. The third vessel will have a capacity of 6,600 tons and

is scheduled for building at the Akers Mechanical Works of Christiania, Norway. The Norway-Pacific Line established American headquarters in San Francisco last October and since then have been operating three large motor ships between the Pacific coast and Norway as regularly as the irregularities of the European situation has permitted. Business has been fairly satisfactory in spite of the super normal handicaps and it is the intention of the company, which is backed by powerful Norwegian interests, to continue to add vessels to the run as speedily as requirements these have been proven the most economical and efficient for the purpose. The three ships now in commission are the "Brazil," twin screw, total h. p. 1500, with tonnage of 4300; the "Bayard," 5300 tons, powered by twin screw engines of 1580 combined h. p., and the 10,000 ton "George Washington" whose total power is 3100 h. p. The first two were built in Norway and the other at Burmeister & Wain's, Copenhagen. The fuel consumption of the "Brazil's" twin set of Diesels is about five tons a day or 35 barrels of motorship oil costing approximately at present \$1.35 a barrel. The fuel cost on the "Bayard" is about the same. The "George Washington" requires 11 tons of oil a day. The "Bayard" on a recent very stormy voyage ran her engines thirty days without stopping.

#### ENORMOUS PROFITS FROM MOTORSHIP CONSTRUCTION.

Very large profits for the last financial year have been made by constructing Diesel-driven motorships by the Burmeister & Wain company of Copenhagen, despite the difficulty in obtaining materials, and the high prices thereof. This company build Diesel-type oil-engines and motorships exclusively. The directors propose out of last year's profit, which is \$3,425,846, to pay 25 per cent dividend to the shareholders, besides adding \$1,114,000 to the reserve fund and \$190,000 to the disposition fund. These funds will total together 8½ million kroner (\$3,070,000). It is further proposed to distribute \$570,000 as bonus to the directors, managers, officials and shipyard workers; to add \$75,000 to the pensions fund, put \$418,000 aside for extraordinary taxes, and carry \$47,880 forward to new account. This prosperous motorship yard is very closely related to the Lord Pirrie interests, who six years ago realized the remarkabilities of motorships.

#### NEW MOTORSHIPS FOR ROYAL DUTCH PETROLEUM COMPANY.

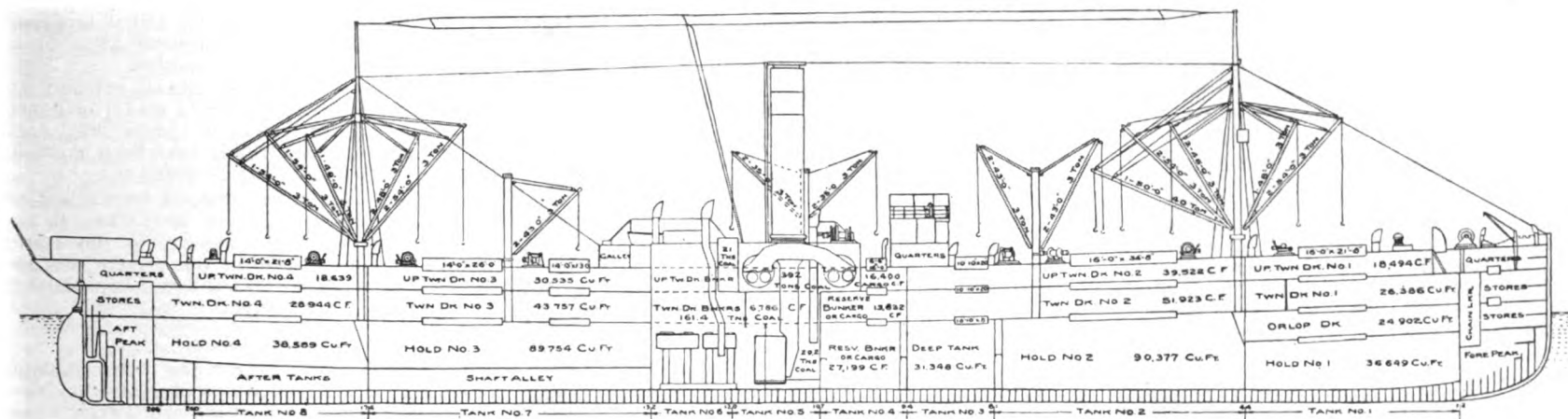
In a statement concerning Royal Dutch Petroleum operations, issued April 9th by Joseph Walker & Sons, of New York, it is stated that there shortly will be in commission some Diesel engine driven vessels for trade to the United States. The operations of the Royal Dutch interests in America are greatly expanding as we previously foresaw, and recently the Roxana Petroleum Co. was incorporated by them with a capital of \$60,000,000. On March 21st their new Cushing refinery opened and has a capacity of 20,000 barrels a day, and the Trumble process has been adopted which greatly simplifies and cheapens the production of gasoline and fuel-oil. They control the Trumble patents. The St. Louis refinery which will have a capacity of 44,000 barrels daily, is nearing completion. Another large oil property and railway has been purchased in Mexico, and a refinery soon will be opened at Curacas, Dutch West Indies, and from there the storage tanks at both ends of the Panama Canal will be supplied with fuel-oil for motorships and steamers. A storage station is under erection at Cape Verde Islands for supplying ships on the South American and South African routes. But the most interesting point of all to Motorship readers is their continued and persistent support of large Diesel-driven motorships, of which they already have a dozen in active service.

#### TACOMA YARDS HOLD OFF CONTRACTS.

J. H. Hyde, president of the Pacific Coast Shipbuilding Co. of Tacoma, reports that their Eastern agents have been offered seven contracts for large auxiliary wooden schooners. Pending the action of the Federal Shipping Board these contracts for private interests will not be accepted by the company.

#### DIESEL ENGINE WANTED.

Wanted—100 to 150 h. p. Diesel engine, either stationary or marine type; single or multiple cylinder; must be in good condition. Paramount Motor Co., 1432 South Parsons Ave., Columbus, Ohio.



SECTION OF STEAMER SHOWING EXISTING MACHINERY ARRANGEMENT.

## An Extraordinary Economy

How a Well-Known American Shipowning Company Will Save \$134,429.00 in Normal Times (or \$370,220.00 in Present War Times) in Four Round Voyages by Converting One Oil-Fired Steamer to Diesel-Engine Power

SINCE the inception of Motorship we have repeatedly urged shipowners to at least devote sufficient time to make a complete study of the motorship question. Looking into the matter in a casual manner and allowing rumors and hearsays, or the inspection of a single early vessel to formulate an opinion is, alas, being done too frequently. This, however, is not always the case. One of the largest and best-known American shipowning companies, has for some time past been making exhaustive studies in this direction, and one little incident that recently occurred has caused them to renew their investigations with increased vigor.

A big Diesel-driven motorship that lately came into New York harbor happened to be of about the same size of one of their oil-fired freight steamships. The fact that this motorship only uses one barrel of fuel oil per three nautical miles, compared with one barrel per nautical mile for their own steamer gave them food for deep thought. It caused them to ponder as to whether it is not time to set quickly their house in order, because the prospect of their business being most seriously affected by such possible competition, that may have to be met in near-future normal times, is by no means an idle fancy. Also the fact that the owners of this particular motorship have entirely abandoned steamers has left them with the impression that the modern Diesel-engined vessel cannot be troubled with all the machinery troubles and repair delays with which they too often are credited, and this impression has been more deeply impressed by the last three great full-powered motorships that lately have entered New York, all having sailed again within three or four days. Their own inspection revealed that no repairs whatever were being, or had to be made, one of them having had no troubles since she had been placed in service. Were there serious troubles these motorships would be forced to stay in port.

Consequently it is not surprising that they have decided to go deeply into the possibilities of converting one of their own steamers into Diesel power, and they are astounded at the enormous economy that will be effected, this running to nearly one-third of a million dollars per annum for the one ship. Yet their own steamer, which is oil-fired, has about reached the maximum economy possible with steam, the consumption averaging

a little under one pound of crude-oil per i. h. p. hour.

Through the courtesy of this company, whose name we naturally cannot give just now, we are enabled to publish plans of the vessel showing her at present, and plans showing the great gain that will be affected by the change. First of all we propose to give a few general dimensions of the ship in her present conditions:

Displacement (loaded).....	19,430 tons
Length O. A.....	484' 0"
Length B. P.....	471' 0"
Breadth.....	57' 0"
Moulded depth.....	35' 0"
Loaded draught.....	30' 10 1/4"
Number of engines.....	Two
Indicated h. p. (total).....	3,500 h. p.
Engine speed.....	98 to 100 r. p. m.
Average sea-speed.....	10 1/2 knots
Daily mileage.....	252 nautical miles
Engines.....	18 1/2" x 28" x 38" x 60" x 36"
Length of engine and boiler room.....	54' 3"
Length of deep tank.....	27' 0" x 57' 0"
Daily oil-fuel consumption at sea.....	36 tons (252 bbls.)
Hourly oil-fuel consumption at sea.....	1.5 tons (0.96 lbs. per i. h. p.)
Consumption in port.....	8.59 tons (60 barrels per day)
Lubricating-oil consumption at sea.....	12 gals. per day
Boiler water carried.....	250 tons
Weight of engines and boilers (steam up).....	495 tons

The cargo capacity is 15,063 tons. There also is a fuel capacity in the double-bottoms and deep-tank of 3,154 tons (less 641 tons ballast) so that the maximum total fuel capacity is 2,513 tons.

Now seeing that the Diesel engines (3,400 i. h. p.) that may be installed only will have a daily consumption of a little under 11 tons it is obvious that not more than 550 tons of fuel for their use need be carried in the double-bottom, as this will give her a cruising radius of about 12,600 nautical miles, or 50 days steaming. This, of course, does not include the fuel required for the auxiliaries, or port purposes, so altogether about 700 tons will be carried. To be exact, the main engines alone will average in actual service about 0.28 lbs. per i. h. p. hour, or 10.2 tons per 24 hour day at sea (a ton of 2,240 lbs. is used in every instance in this article.—Editor.)

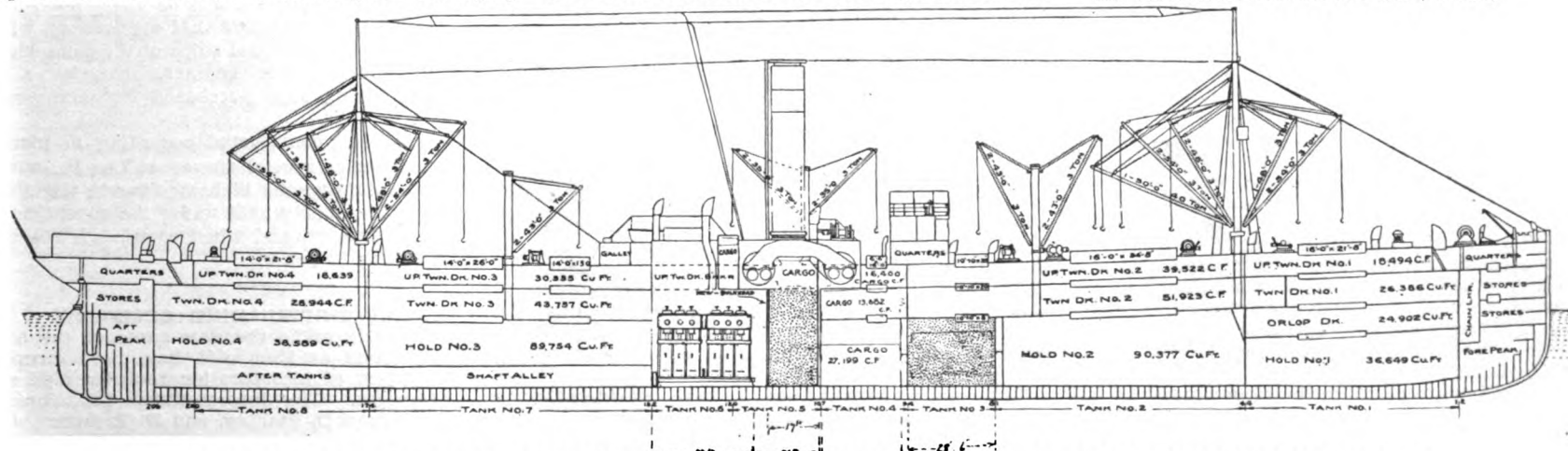
Hence it is obvious that the deep tank can be entirely given over to cargo and this means a space of 31,348 cubic feet, or 880 tons of cargo. This, however, is by no means the maximum for, when heavy compact cargo such as machinery is being carried, it will be possible to take on board over another thousand tons of cargo without the

hull dropping below the Plimsoll mark. Also 150 of the 250 tons of water which now is carried for boiler will no longer be carried, and there also is a saving of at least 100 tons in the machinery weight and space.

Thus the general utility saving is 1,130 tons, but the maximum cargo gain under special circumstances will be at least 2,000 tons, and is a mixture of bulk and weight tonnage. This we will discuss presently, but first we will give an idea of the motors to be installed.

The Diesel engines under consideration are of two makes, but we will take one design only for comparison purposes. This design happens to develop a little less power than the present steam machinery, as each motor will only normally develop 1,700 i. h. p. at 120 r. p. m., although the maximum continuous power is a little over this figure. So it is possible that the speed of the ship may be reduced by a quarter-of-a-knot; but this cannot be properly ascertained until they are installed because there will be a reduction in the displacement of the ship, (due to the lessened machinery and fuel weights), even with the increased cargo-capacity, so that her load line will be changed. Furthermore, as Diesel engines will maintain their speed without varying a revolution from the beginning of one week to the end of the next week, and because they do not "race" when the propeller leaves the water in heavy weather, it is very probable that the average speed maintained by the ship for a period covering one year will work out the same as before, although not so much power will be developed, neither will the trial speed be so high. This particular feature of the Diesel engine would seem to be entirely overlooked by the average shipowner, the constancy of the Diesel engine being most valuable in securing steady speeds. Here are the Diesel details.

Total indicated-horse-power of Diesel engines.....	3,400 h. p.
Total shaft-horse-power of Diesel engines.....	2,600 h. p.
Probable engine speed in service.....	115 r. p. m.
Weight of main engines together.....	312 tons
Length per engine.....	30' 3"
Height per engine.....	18' 1"
Width per engine.....	9' 3"
Type.....	Four-stroke-cycle
Bore and stroke.....	600 mm. by 1,100 mm.
Daily oil-fuel consumption at sea.....	10.2 tons (71 bbls.)



SECTION SHOWING DIESEL ENGINE ARRANGEMENTS AFTER CONVERSION TO DIESEL. SHADED SECTION SHOWS CARGO SPACE GAINED.

Hourly oil-fuel consumption at sea ..... 952 lbs. (0.28 lbs. per i.h.p. hr.)  
 \*Daily consumption of auxiliaries at sea ..... 0.75 to 2 tons  
 Daily fuel consumption in port, 3 tons (21 ibbls.)  
 Lubricating-oil consumption at sea ..... 30-35 gals. per day

\*The consumption of the auxiliaries at sea will depend upon the decision to change the donkey-boilers and install sets having a larger heating surface in order that steam may be produced by means of the exhaust gases from the main engine, the mean-indicated-temperature of which will be about 750 degs. Fahr. In the daytime sufficient steam should be maintained to operate the steering gear. At night, and in port, the oil-fired burner would be used. This would save 1 ton of oil per day. If the present donkey boilers are in poor condition it undoubtedly will pay to make the change, otherwise it is a point to be very carefully considered.

In working out comparison costs between the converted ship and her present operating expenses we will first deal with the fuel question. Because of the uncertainty of the question of how the auxiliaries are to be operated we will take the daily sea consumption of all the machinery as 11½ tons. The time spent at sea each year we will take as 250 days and the cost of the Diesel fuel as \$1.75 per barrel, which is 25c per barrel more than that now paid. The donkey boilers will use the cheaper oil fuel.

This gives us a yearly consumption at sea of

being built in the U. S. A., or purchased abroad. Hence, the entire cost of conversion including structural alterations to the hull, should not exceed \$220,000.00. It may be considerably less than this, as these particular figures are not builder's estimates. If the engines are purchased abroad they will be admitted entirely free of customs duty, because she is an existing American-built vessel.

Seeing that the earning capacity of this ship will enormously be increased due to the extra cargo carried (which we presently will discuss) the entire cost of conversion and time lost while the ship is laid up should be paid off within a year, so the investment will be a most profitable one for the owners.

It will be noticed that the absence of boilers gives a space of 17 feet forward of the engines, which also can be used for cargo carrying. This represents another 100 cubic tons gained. It will be necessary for the owners to remove the screen bulkhead in the engine room and thus enable this space to be used for cargo. In which case, the total cargo-space gained is 45' by 57', or the equivalent of about 1,526 tons (cubic measurement) all told; but a bulkhead will have to be fitted in place of the present screen bulkhead in the engine room to separate it from the cargo space. Over the engine room are coal bunkers of 392 tons and 21 tons respectively, all of which already are used for cargo.

they can check for themselves; and it is almost incredible to believe the enormous gains to be made by a fleet of such motorships.

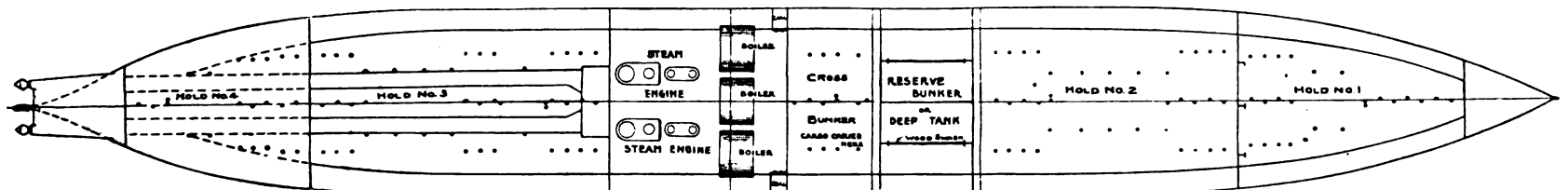
Ten such vessels mean an annual economy (in addition to profits already being made) of nearly four million dollars. These figures may seem grossly exaggerated, but they have been carefully checked by the shipowners in question.

One point to which we desire to draw attention, and that is, there is plenty of saving here to pay thousands of dollars in repairs, to the Diesel engines, as the earnings of the present steamer are now more than \$370,000.00 less than what they will be after the conversion.

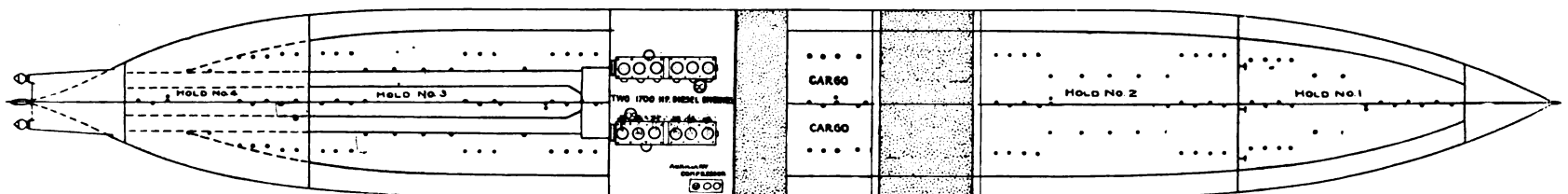
#### Appendix.

Since the foregoing article has been completed the owners of the ship under consideration have drawn our attention to a little clerical error which when corrected means an additional \$3,780.00 added to the Diesel motorship's fuel economy. We have given the motorship a fuel consumption for 250 days at sea, whereas we accidentally gave the steamer only 240 days at sea. They should both be the same.

Ten more days at sea for the steamer will mean 2,520 additional barrels of fuel at \$1.50 per barrel, or \$3,780.00. As this must be placed to the favor of the motorship, the annual economies affected by the latter will be increased to \$138,200 in normal times, or \$354,009 in present times.



PLAN OF STEAMER SHOWING AMOUNT OF SPACE NOW OCCUPIED BY THE STEAM ENGINES, BOILERS AND RESERVE BUNKERS.



PLAN SHOWING DIESEL INSTALLATION AND AMOUNT OF CARGO SPACE (SHADED) GAINED BY THE CONVERSION TO MOTOR POWER.

2,875 tons (20,125 barrels) which gives an annual fuel bill of \$35,218.75. As the balance of the time will be spent in port, we have an additional yearly consumption of 345 tons (2,415 barrels at \$1.50 per barrel), for the donkey boilers, which works out at \$3,622.00. In port the main engines are shut down. This gives the motorship a total fuel bill of \$38,840.75 per annum.

Regarding the steamer. She uses a little heavier grade of fuel than the owners would desire to use with the motorship, and for this they pay \$1.50 per barrel. Now, her daily consumption at sea, being 36 tons (252 barrels) a year of 240 days, means 8,640 tons (60,480 barrels) at a cost of \$90,720.00 per annum. To this we must add the yearly port consumption of 6,900 barrels (985½ tons) at \$1.50 per barrel, or \$10,350.00. Thus we get total fuel cost results as follows:

Steamer .....	\$101,070.00
Motorship .....	38,840.75

\$ 62,229.25—Economy Effected

From this we have to deduct the greater lubricating oil bill of the motorship, namely, about 5,520 gallons extra for 240 days. But as there are no stand-by charges with Diesel engines in port this should equalize matters. Anyhow the difference in fuel cost is about 300% in the motorship's favor.

Over the engineer question these owners anticipate no difficulty whatever, in fact they have a simple plan which can hardly fail to work with success. There will, of course, be no firemen carried, except the donkey men, but the engine staff will be slightly larger, and will have better wages, so here again matters will work out about level. It will cost a thousand, or so, dollars to train the first men, as they will be sent to the shops for a couple of months.

Generally speaking the present steam-engine-room auxiliaries will be retained. The cost of conversion will, of course, depend upon the number of changes that will be made. The two main engines together roughly will cost between \$150,000 and \$180,000 (probably less) at today's high price, and spare parts, auxiliary compressors, air-tanks, etc., may run into another \$10,000 to \$20,000, the price of the engines depending upon their

In view of the foregoing it is perfectly feasible that with a general cargo at least 1,556 additional cubic tons of freight (62,300 cubic feet) will be carried after the conversion to Diesel power has been made, and many of the double-bottom tanks no longer will be burdened by the weight of the huge quantity of fuel oil, as no more than 700 tons fuel will be carried as a maximum. But for the purpose of estimating a conservative figure we will say that the gain is 1,500 cubic tons (or 2,100 tons net weight capacity, due to reduced fuel machinery and water weights). Four round voyages per year of 80 days each with freight rates at \$12 per ton (today the rates received by these owners vary from \$20 to \$50 per ton according to its nature) means a gain over the past earning power of no less than \$72,000 per annum, or a total of \$134,229 with the fuel-bill saving added. This purely is a matter of simple calculation which any shipowner can figure out for himself. With today's freight rates the gain will be as high as \$288,000.00 for freight alone.

Hence we can easily figure out the total benefits to be derived from the conversion of this particular steamer to Diesel motor power, if the conversion is done as cheaply as possible. If more money and time is spent on the work the ultimate economy and gain will be much higher. But, in the latter case a new ship may as well be built and the old one disposed of, so we presume that the job will be carried out as reasonably as is feasible. The following is at today's freight rates:

Annual earning capacity of cargo space gained.....	\$288,000.00
Annual saving effected in fuel bill.....	62,229.00
	\$350,229.00

Previously we pointed out that the maximum amount of extra cargo (such as copper) that can be carried under special circumstances is about 2,000 tons, hence at certain times the earning capacity of the ship will be even greater than the figures heretofore quoted. But the foregoing amount should be sufficient to satisfy any respectable shipowner.

Most shipowners appear to take considerable convincing as to the real economy of motorships, but, here are drawings, figures and facts which

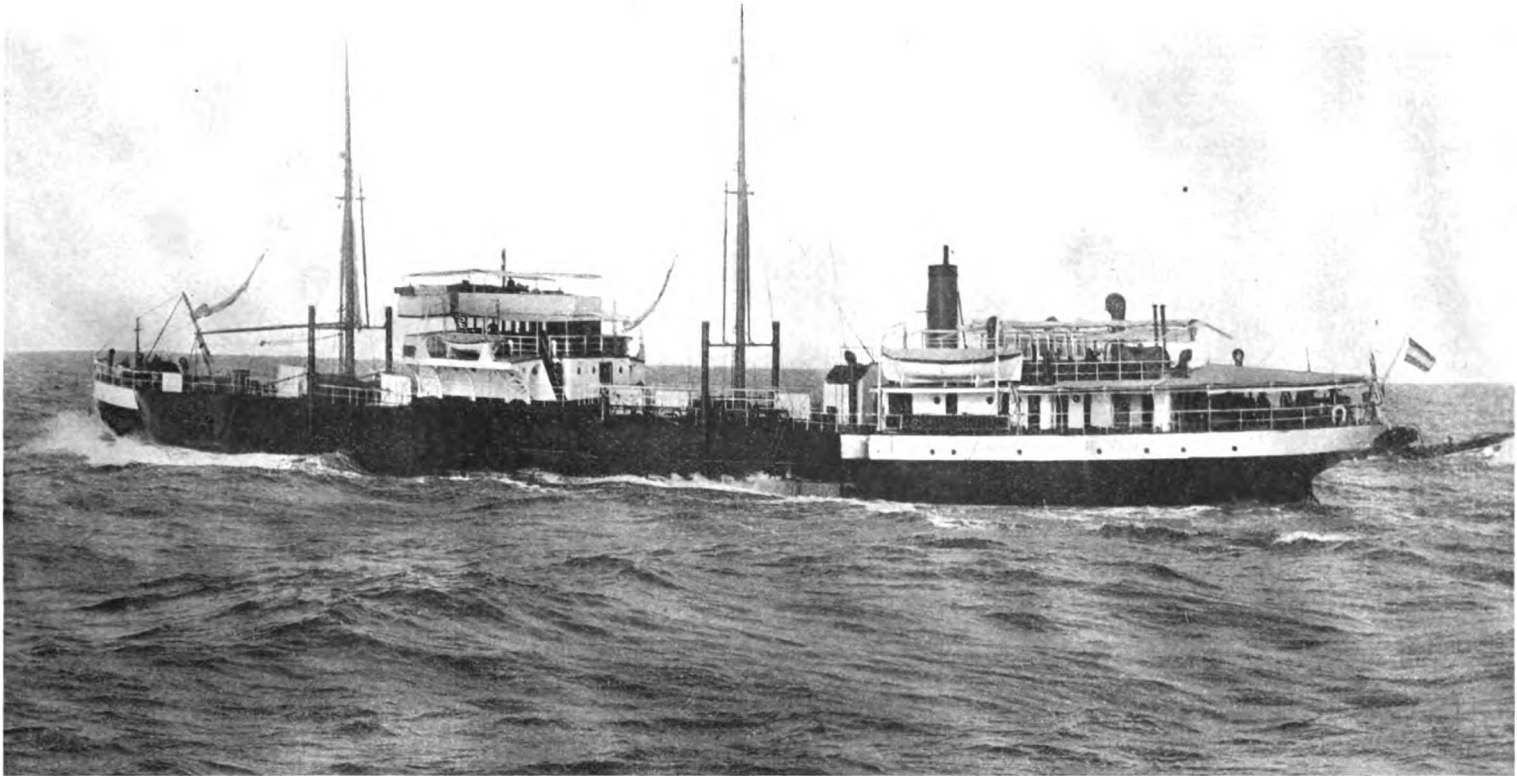
#### BRITISH COLUMBIA SHIPBUILDING COMMISSIONERS REPORT.

The Commissioners appointed by the B. C. Government to administer the B. C. Shipping Act, have presented their first report over the signatures of H. P. Thompson, Superintendent, and W. J. Goepel, Deputy Finance Minister, as follows: Under section 53 of the act we have received application for the following ships: 1 Mabel Brown, 2 Geraldine Wolvin, 3 Jessie Norcross, 4 Marie Barnard, 5 Mabel Stewart, 6 Janey Caruthers, 7 Margaret Haney, 8 Laurel Whalen. All of these boats are being built for the Canada West Coast Navigation Co., Ltd., and are of the same standard size and specifications, which are as follows: Five-masted auxiliary schooners, length over all, 260 ft.; beam, 44 ft.; depth of hold, 19 ft. They will be equipped with auxiliary power, using oil-fuel, Bolinder type of engines which will develop 320 h. p. Under normal conditions the ships will make a speed of 7 knots under engine power and will each require a crew of about 15. The cargo-carrying capacity is estimated approximately at 1,500,000 ft. of lumber. The approximate cost of each of these vessels when completely equipped will be about \$200,000. They are informally advised that applications will be made for four additional ships of the same size and specifications, the engines, material and equipment having been purchased for their construction.

They are being constructed according to plans passed and under special survey of Lloyd's, with a view to obtaining the highest class in the register. They are being built under the supervision of Lloyd's surveyor, and when completed will be classed A1 for 12 years.

#### ROLPH SHIPBUILDING COMPANY.

The above is to be the new name of the old Bendixen yards at Humboldt Bay, Cal., according to articles of incorporation recently filed at San Francisco. The incorporators are James Rolph, Jr., John D. Stelling, and D. F. Ewart, all of San Francisco.



M. S. "JUNO," DIESEL DRIVEN TANKER BUILT 1912, OWNED BY THE ANGLO-SAXON PETROLEUM COMPANY OF LONDON. ENGINED BY THE WERKSPOR COMPANY OF AMSTERDAM. UNDERWENT HER SECOND LLOYD'S SURVEY JANUARY, 1917, WITH LITTLE IN THE WAY OF REPAIRS NECESSARY TO MOTOR, WHICH IS 1,100 B. H. P. (1,460 I. H. P. AT 115 R. P. M. EQUIVALENT TO 1,300 STEAM I. H. P.). VESSEL IS 258 FEET B. P., 45 FEET BEAM, 18.6 DRAUGHT, 4,300 TONS DISPLACEMENT, CARRIES 2,500 TONS CARGO ON A D. W. C. OF 2,675 TONS AT AN AVERAGE LOADED SPEED OF 9 3/4 KNOTS.

## Fueling the Thousand Wooden Vessels

An Extraordinary Situation Likely to Arise in Connection With the Shipping Board's Fleet.—Diesel-Driven Motorships the Sole Solution

THROUGHOUT the world interest has been aroused by the Shipping Board's announcement that it intends the immediate construction of 1,000 cargo ships of about 3,000 tons D. W. C. each in which are to be installed either oil-fired steam-engines, or oil-motors, of 1,400 to 1,500 i. h. p. per ship, in either twin or single screws. At the time of writing no actual and final decision as to the type of power to be installed has been made, but according to reports the inclination of the officials of the Board now leans towards oil-fired steam-engines, because they believe that such machinery can be obtained quicker than motors; but, we fail to see how steam-engines, boilers and condensers can be obtained quicker as a unit than heavy-oil consuming internal-combustion-engines.

So far as we have been able to ascertain no attempts have yet been made to make the very necessary arrangements for fueling these vessels, and certainly the existing Atlantic Coast fuel-stations are quite inadequate to handle the enormous amount of fuel that these vessels will require when all are in regular service, for no fueling can be done in Europe except in special circumstances, because the Allies have to import all their oil-fuel by means of tankers, hence all the 1,000 wooden ships must carry sufficient oil for a round voyage.

Each oil-fired steam-driven vessel, if of 1,400 i. h. p., will have a daily consumption of not less than 15 tons—this on a moderate basis of 1.0 lbs. per i. h. p. hour. Thus, one thousand steamships will together have a total fuel-consumption of 15,000 tons (105,000 barrels) per 24 hours.

A round-voyage to Europe and harbor time will take about one month (30 days), in fact, 12 voyages a year would be the maximum, which means that every month a supply of oil must be shipped to the fuel-depots in Atlantic Coast harbors to the extent of not less than 450,000 tons (3,150,000 barrels),—that is to say, 5,400,000 tons (thirty-seven million barrels per year).

Mexican and Texan crude-oils must mainly be used, and possibly some Pennsylvanian and even Californian oils may be used as fuel, so it means that, in order to maintain this supply at the depots, no fewer than 68 steel tankships of about 6,000 tons D. W. C., each carrying 5,000 tons of oil-fuel, will be required in regular operation,—

this on a basis of three weeks round voyage per tanker. In other words about one tanker to every 16 freighters is needed. This could be changed to 34 tankships each of 10,000 tons cargo-carrying-capacity (about 11,000 tons D. W. C.).

By making each tanker tow a tank barge even this number of tankers could be reduced; but their speed would be less, hence the voyages would take longer, and fewer trips would be made in a year. But, can either the barges or the tankships be obtained? The answer is in the negative! At least three years must elapse before they could be built, as they must be constructed of steel. Pipe lines cannot be relied upon as they are required for the better-grade oils.

What can be done? may be asked. Now, 1,000 four-cycle Diesel-driven wooden freighters of 1,400 i. h. p. will only require 3,800 tons (26,000 barrels) of oil-fuel per diem, or about 114,000 tons (798,000 barrels) per month, so that eight tankers of 10,000 tons and one tanker of 5,000 tons could maintain the oil supply for such ships at the depot, even without the use of barges, which is quite a different matter from the requirements of the steamers.

One thousand hot-bulb ("semi-Diesel") engined ships would require about 200,000 tons (1,400,000 barrels) of oil-fuel per month, and would need fifteen 10,000 tons tankships or thirty 5,000 tonners in regular operation.

No matter what class of ships are built, they cannot operate without fuel, and every existing tankship already is worked to its limit. The British, French, American and Italian navies at present have first call on the existing oil tankship service, as also do the many oil-fired steamships now in operation, so that new tank vessels certainly will be required for the Shipping Board's fleet, if steam-driven. As tankers must be built of steel, where is the Shipping Board going to obtain the sixty-eight 5,000-tonners, or the thirty-four 10,000-tonners, which will be needed if 1000 oil-fired steam-driven freighters are built?

If fuel-oils have to be obtained from California the situation will be far worse because more tankers will be necessary, as the voyages to the Pacific Coast will take twice or three times as long.

The answer is that the Shipping Board will be obliged to devote their attention to Diesel-driven

motor freighters, which only require one-fourth of the fuel. A thousand Diesel ships will only need 1,368,000 tons of oil-fuel per annum, which is quite a different matter to the 5,400,000 tons needed by steamships. There is a direct saving in fuel transportation of 4,032,000 tons (28,224,000 barrels) per annum. The saving in cost of transportation alone will reach an enormous sum annually. The actual cost of the fuel saved by adopting Diesel ships, figuring at \$1.50 per barrel, will mean \$42,336,000 per year, which almost seems unbelievable, yet is a fact.

Furthermore, each Diesel ship will carry at least 300 tons more cargo than a steamship of the same dimensions (because of the less fuel carried in the ship's bunkers) which means that the entire fleet will carry 300,000 more tons per voyage, or a grand total of 3,600,000 tons more of cargo per annum if twelve round voyages are made carrying cargo to Europe and returning in ballast.

In other words, one thousand motorships will carry as much cargo as eleven hundred steamships of exactly the same dimensions, and yet the fuel-bill of these 1,000 motorships will be about one-fourth that of 1,000 steamers.

### SANDSTROM SHIPBUILDING COMPANY.

This new company, locating at Salmon Bay, Ballard, Washington, will be under the management of Herman H. Sandstrom, recently superintendent of the Standifer-Clarkson Shipbuilding Co. of Portland. J. M. Farrell, a well-known Seattle lumberman, will fill the office of president and treasurer. The Sandstrom Shipbuilding Company will build large wooden vessels in which oil engines will be installed.

### MARINE IRON WORKS.

One of the latest incorporations is that of the Marine Iron Works of Seattle. This company is reported to have purchased lot 1, block 452, of Seattle tide lands, which is located just south of the Port Ferry landing at West Seattle.

The officials of the Marine Iron Works are as follows: Peter C. Peterson, president; Archibald McLean, vice president; Frederick H. Dutton, secretary and treasurer. Prominent among the stockholders is C. J. Erickson.

The company proposes to build wooden vessels.

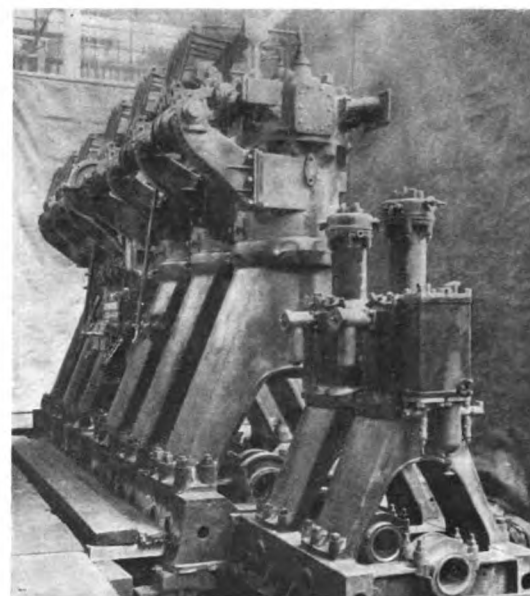
# A French Mercantile Diesel Engine

CONSIDERABLE development of the marine Diesel oil-engine has been done in France, and all the big shipbuilding concerns in that country have accomplished something in this direction, among whom may be mentioned the Société Anonyme des Chantiers et Ateliers Augustin Normand of Havré (Augustin Normand Shipbuilding Co., Ltd.), whose chief product is torpedo-boat-destroyers, add details of their submarine-type marine Diesel engine will be found in one of the parts of the article on "Submarine-type Diesel Engines of the World's Navies."

We are enabled to give illustrations and details of the mercantile-type of Diesel engine as designed and built by the Normand Company, and so far as we can trace this is the first published intimation that they had built oil engines for merchant ships. Like the Dow-Willans engine, which we illustrated in the February issue, it is a development from a stationary motor, consequently the two are not unlike in general appearance; but that really is due to both engines being of the A-frame type, and in reality they differ considerably. Both designs, however, are at variance with the majority of other European designed marine-oil-engines. Apparently the Normand motor is a development of the single-cylinder 50 h. p. set that they exhibited at the Eiole Centrole des Arts et Manufactures, at Paris in 1913.

The revolution speed of these Normand mercantile marine engines are not very low, being 240 r. p. m. for models with cylinders 11.4 in. bore by 16.5 in. stroke, and 210 r. p. m. for models of 13.5 in. bore by 19.2 stroke, which develop 35 b. h. p. and 50 b. h. p. per cylinder respectively. But as the engine illustrated develops 500 b. h. p. in six cylinders, the bore and stroke obviously is greater, while the speed probably is 200 r. p. m., which is reasonable for a trunk-piston class of engine of this power. Most European marine builders adopt crossheads and guides for a Diesel engine of about this power and speed; but the Normand designers in their endeavors to reduce additional working parts evidently consider it quite safe to dispense with them, and trust to the long trunk-pistons to absorb all the side-thrust. The 500 b. h. p. engine illustrated is 23 ft. 3 in. long, by 6 ft. 9 in. high above shaft center, and 6 ft. 7 in. wide. Its weight, including two air-compressors, is 5,523 lbs., or a little over 33 lbs. per b. h. p., which is heavier than some cross-head-type engines, and is due to the heavy bed-plate and A-frame construction. At the same time it cannot be considered excessive for a merchant-ship engine.

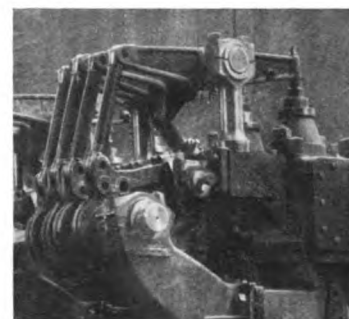
Augustin Normand Co. have had particular success with earth-nut oil as fuel, also with tar-oils, mineral-oils, and other vegetable-oils. When very



6-CYLINDER 500 B. H. P. NORMAND MARINE DIESEL

heavy oils are being used starting is effected on kerosene, this being injected by means of a special pump, this pump also working simultaneously with the main pump when the motor commences to operate on a reduced charge. The reason for the two air-compressors shown is to ensure that the operation of the engine should not be interrupted by a leaky joint, or accident to the compressor, as either has sufficient output to charge the air-bottles, and to supply the injection-air. Furthermore the extra supply available will allow of considerable manoeuvring to be carried out without starting up the engine-room spare compressor. Both of the two compressors are of the two-stage type, and are driven off the main crank-shaft at the forward end of the engine.

The cylinders and the A-frame, it will be noticed, all are simple castings, the former carrying the cast-iron brackets which support the camshaft bearings. Because of this method of construction it has been necessary to fit detachable heads, so that the pistons can be removed from above.



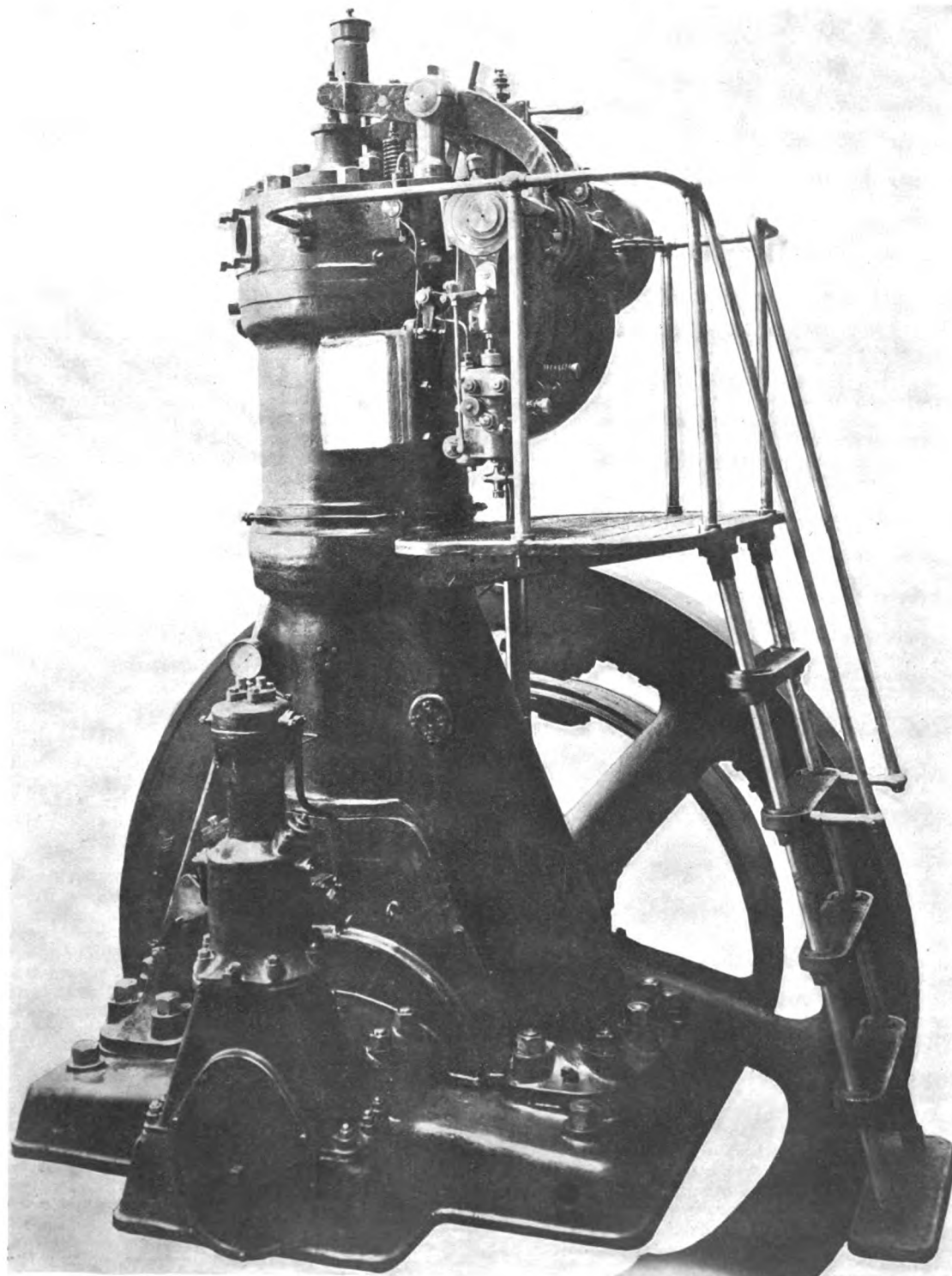
VALVE MECHANISM OF NORMAND DIESEL

These heads are very deep in order to give plenty of cooling-water space.

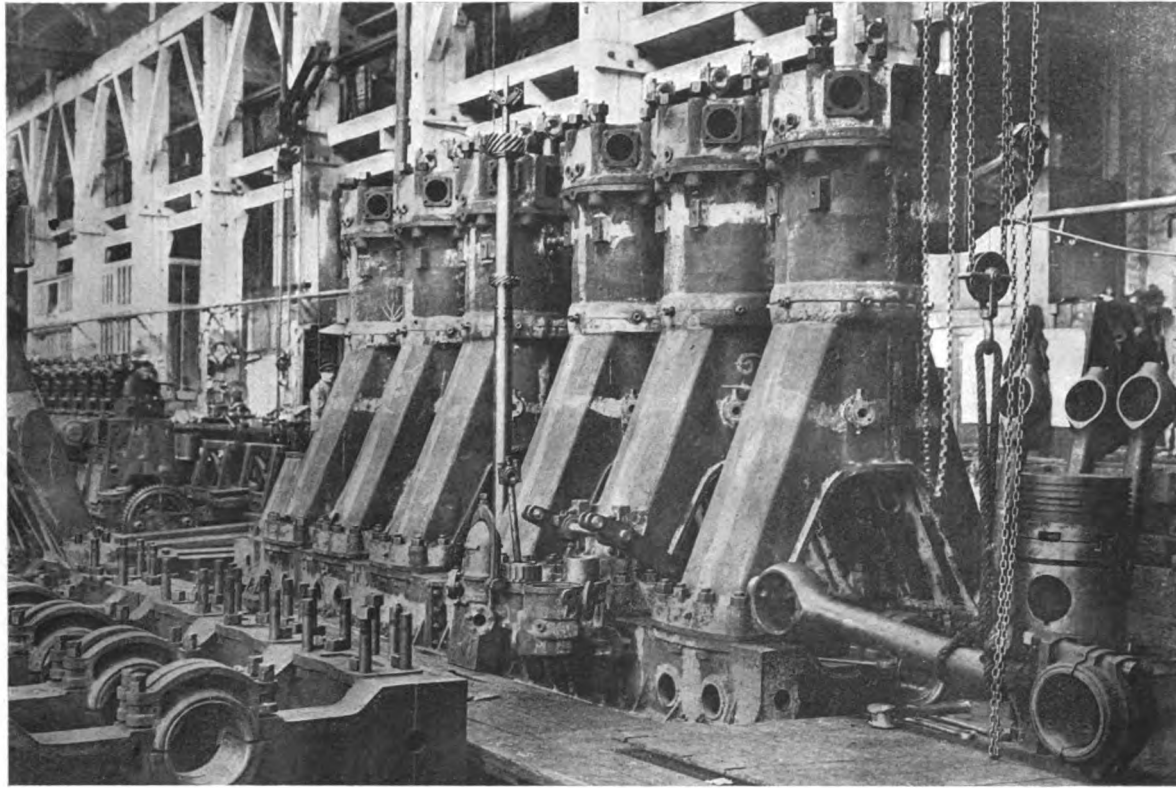
By dividing the engine into two sets of three cylinders with the camshaft driving-rod between it is possible to cut out three cylinders and run on the other set in case of accidents, but the main purpose is, when starting and manoeuvring, to run three cylinders on air until the others pick up the load on fuel.

Being of the four-cycle type there are five valves in each cylinder head, namely the inlet, exhaust, air-starting, fuel-injection, and relief valve, and the latter can be pneumatically operated in order to reduce the cylinder pressure when reversing or when starting. The rockers for the inlet and exhaust valves are eccentrically mounted, and the normal motion of the rockers is transmitted from the cams by means of short push rods, hence when manoeuvring a twist of the eccentric fulcrums of the rockers raises the push-rod rollers clear of the cams.

Accurately speaking there are no rollers attached to the push-rods, but the lower ends of the latter are attached to a swinging-lever carrying two rollers, one end of the swing-lever being mounted on an auxiliary, or lay-shaft, situated between the camshaft and the cylinder-head. This lay-shaft has a rotation of 180 degrees, and when it is turned by the engineer, the swing-levers



AUGUSTIN NORMAND CO. SINGLE-CYLINDER DIESEL ENGINE EXHIBITED IN PARIS 1913



TWIN SET OF 520 B. H. P. NORMAND DIESELS IN COURSE OF ERECTION

move to and fro as desired, thus pushing into position on the ahead or astern cams, either the ahead or astern rollers, the cams being side by side. In other words, changing the rollers sets the opening of the valves at the right time for the ahead or astern motions, each roller being caused to fall on its proper cam. Thus is reversing carried out in a very simple manner, no axial or fore and aft displacing of the camshaft being required.

Separate fuel-pumps are fitted for each cylinder and their suction valves are raised by a movement of the control lever. Displacement is insured by a guide spring, but no matter the position of the control lever the fuel can be cut off, thus nulling the action of this spring. In the same manner does the governor act, but except to limit

the engine speed it does not come into operation.

The crankshaft of the engine is in two sections, and on the coupling connecting the two sections is mounted the helical-gearing that drives the vertical rod that operates the camshaft, and in this manner the opening of the valves is not affected by the possible twisting of the after end of crankshaft, as it may be were the rod situated at the forward end. The water-cooling-pump is of the plunger type, and is mounted on the bed-plate at the back of the engine. It is driven by rocker-beam motions, the lever being mounted between two of the A-frames of the engine.

Turning to the lubricating arrangements, we note that the oil discharged from the bearings and connecting-rod ends flows into a sheet-iron

tank, which is fixed directly on the engine bed. The oiling is effected by gravity, all the feeds being visible and can be regulated. Oil is fed to the connecting-rod-ends by means of centrifugal crowns, and after having done its work is filtered and purged of water which might mix into it. Thence it passes down into containers where a certain quantity of new oil is added. But lubrication of the cylinders is effected under pressure by a multiple piston-pump. All the introduction poles are within reach and can easily be stopped. The bottom of the connecting rod is lubricated by the oil from the cylinder walls, scraped off by a large ring groove, which feeds the hollow centre line and which has oiling holes.

#### BELSHAW DIESEL TYPE ENGINE

**A**N interesting engine now being demonstrated by the Belshaw Engine company of Everett, Wash., the main and original feature of which is a system of fuel injection dispensing with blast air.

The demonstration engine, which has been in operation for eight weeks, is of the stepped piston two-cycle single-cylinder type, 4x6 developing in excess of 4 b. h. p. at 350 r. p. m. The scavenging air is trapped in the usual way, but the air chest has considerably greater capacity than the cylinder. The fuel injection pump is 3/16 dia. and 5/32 stroke and is regulated by a governor in addition to a cam adjustment.

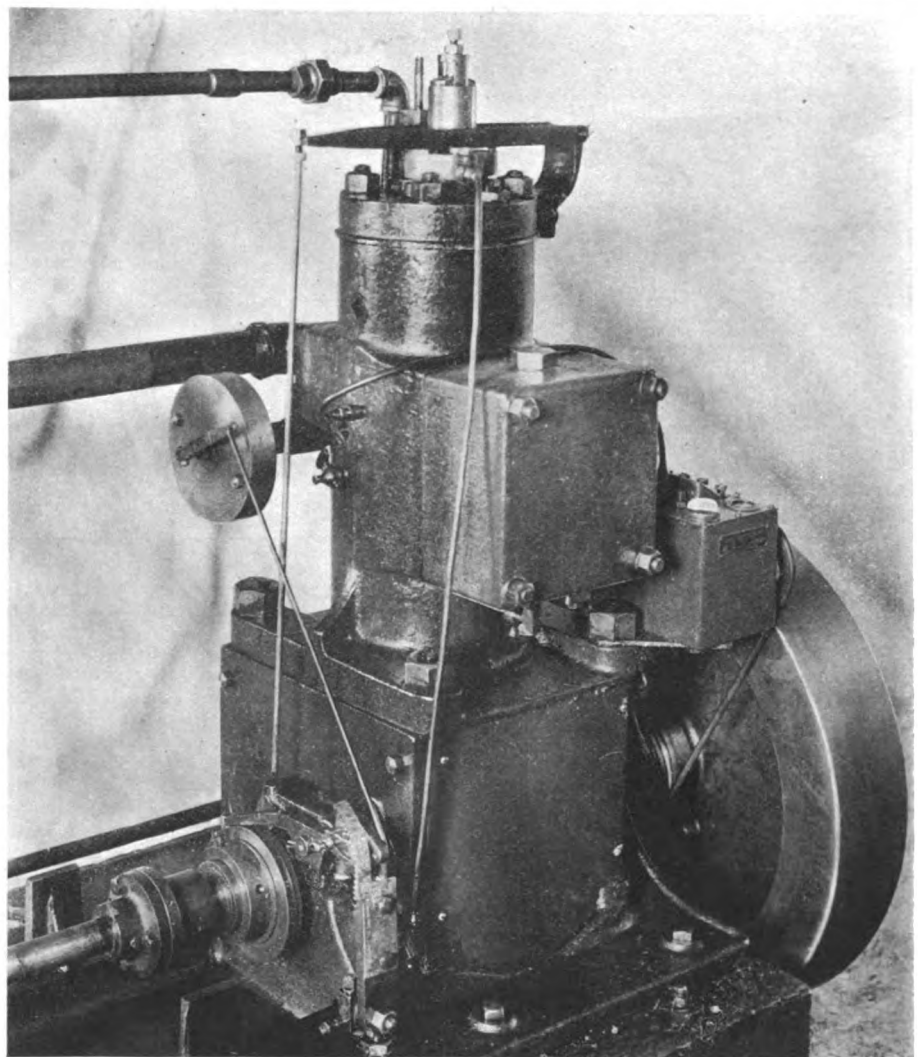
As a small engine of this size can be started by hand no air is used for this purpose. There is no torch, nor any electrical contrivance for ignition, the principle being the true Diesel cycle. The mechanical device for injecting and atomizing the fuel (patents applied for), and which is placed in the center of the cylinder head, can be operated in any manner which will give a slight lift to its one moving part.

In this particular engine, as may be seen in the illustration, it is operated from an eccentric on the main shaft by means of a push rod and horizontal arm. The fuel oil reaches this device at about a 4-lb. pressure, but what takes place between this point and it reaching the cylinder is and will remain a closely guarded secret until the patents have been granted.

Upon examination of the cylinder head after removal, all that we could see were two openings on the under side, one for the release or safety valve and the other for the fuel injection, but the latter which contained a piece of waste prevented closer inspection.

As the cylinder head had not been off during the past eight weeks it was interesting to note the clean condition of piston, cylinder head and walls. After the midday interval with everything stone cold the head was bolted back in place and a careful examination made of the flow and quality of oil before connecting fuel pipe to the injection device after which the flywheel was rocked twice against the compression when she started. This engine is driving a lathe, drill press, etc., six days out of week and the measured consumption averages a trifle less than two gallons of caloil for the 10 hours run, on a slow speed, developing about 3 to 3½ b. h. p. The engine apparently operates just as well at 50 r. p. m., something which a hot-bulb or surface ignition engine will not do for long.

There is no hot-bulb, plate or cup used, nor (as formerly mentioned) is the oil sprayed into the cylinder.



BELSHAW EXPERIMENTAL ENGINE USED FOR DEMONSTRATING FUEL INJECTION SYSTEM

# The Spanish Auxiliary Motorship "Suarez"

IN these days of crude-oil engines little publicity would seem to be given to merchant vessels that are equipped with electric-spark ignition type of kerosene, or gasoline, motors, yet there are quite a number in service. A case in point is the Spanish auxiliary schooner "Suarez," which is driven by an American-built motor, and which has been in service about a year, operating out of Vigo, Spain.

The "Suarez" originally was built at Liverpool in 1869 by Raj, Evans & Co., and was run under the Norwegian flag, then being known as the "Fredsel." A few years ago she was partially dismantled, and was used for storage of coal, but during the recent demand for tonnage, her owners decided to re-fit her and instal a motor for auxiliary power. The engine selected was a six-cylinder Wolverine four-cycle class kerosene motor of the electric-spark ignition type, 11 ins. bore by 15 ins. stroke, developing about 200 to 225 b. h. p. at 300 r. p. m., on a piston displacement of 5159 cubic inches. This engine is non-reversible and drives the propeller through a clutch and reverse-gear, the clutch being of the expanding and contracting internal friction ring type. The owners, we understand, report complete success in every respect.

The following are the general dimensions of the "Suarez":

Length.....	190' 7"
Breadth.....	32' 0"
Depth.....	20' 0"
Draught.....	18' 0"
Regular tonnage.....	832 tons
Carrying capacity.....	1,500 tons

The engine is so equipped that it can be converted to use producer-gas when coal becomes available at more reasonable prices, but, of course, a producer plant will have to be installed. A few descriptive details of the Wolverine engine doubtless will be of interest, particularly as it is of American design and construction.

The L headed cylinders are cast separately,

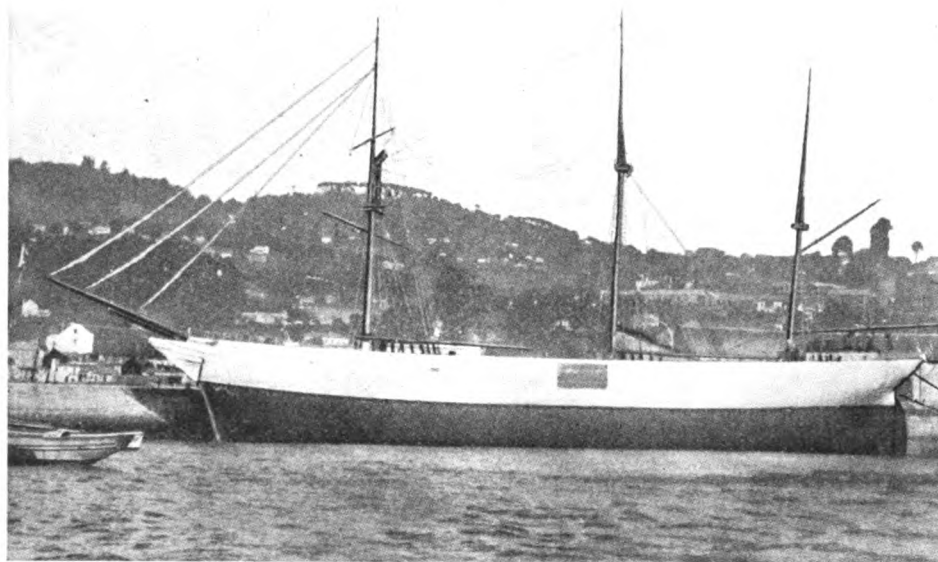
with the inlet and exhaust valves arranged on the port side, and are mounted on a cast-iron crankcase formed in two sections. Of the ordinary mushroom type, the valves are operated off the usual horizontal camshaft, which in turn is driven by a set of three spur-wheels at the forward end of the engine, the wheel being covered by a metal guard. The ends of the valve tapped rods are forked, the forks each containing a roller. To each rod two adjustable locknuts are provided for adjusting the valve lift. It should be mentioned that the camshaft is not enclosed and runs in four babbitted bearings mounted on the outside of the crankcase.

For starting there is a half-compression gear,

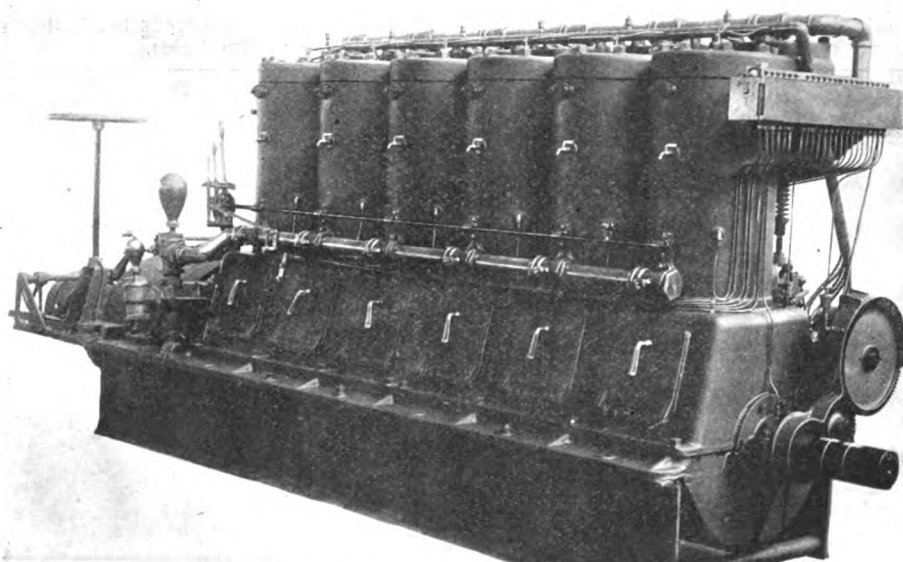
the operation and construction of which is of interest. The pin, on which the exhaust taper roller is pivoted, is extended, and on it a collar is mounted. To this collar is attached one end of a lever, the other end of which is secured to a small shaft which can be moved fore and aft by means of a small hand-lever. Upon moving the lever the collar attached to the tapped fork is moved on to an auxiliary cam, which thus raises the exhaust valve during the inlet stroke, and allows the crankshaft to be turned over without trouble. By providing the cylinders with removable heads, each held down by eight nuts, the piston tops and cylinder walls can be inspected, or the pistons and connecting-rods removed, without dismantling any gear otherwise than the cooling water connections. Separate covers are fitted to the valve chambers, which are cast separately from the cylinders, allowing any valve to be quickly replaced or attended to. The gudgeon pins are secured to the connecting rods, and work in bronze bushes fitted in the sides of the piston.

On the forward cylinder is mounted a multiple sight-feed lubricator of the double-pump type, the latter being operated off an eccentric mounted on the camshaft extension. From the lubricator, pipes with adjustable feeds are led to each main bearing and the cylinder walls. The same eccentric operates a plunger-pump for water-cooling the engine, and also a small air-compressor for providing compressed air for any purpose necessary, such as the syren. The water-pump is on the star-board side at the after end, while the air-compressor can be seen at the base of the crankcase on the port side. The carburetter is of the ball-valve float-feed type, and is, of course, attached to the vaporizer, which is heated by exhaust-gases. The vaporizer is water-cooled, as is the exhaust branch, the amount of water being regulated according to the heat required.

Ignition is by a high-tension gear-driven magneto, and spark-plugs. The net weight of the engine is 11,130 lbs. or about 5 tons, and the crankshaft has a diameter of 4¼ inches.



"SUAREZ," 1,500-TON SPANISH AUXILIARY EQUIPPED WITH AN AMERICAN MOTOR



225 B. H. P. WOLVERINE INSTALLED IN "SUAREZ"

## Announcement of Considerable Interest to Oil Engine Industry

AN announcement that is warranted to create widespread interest in the distillate and internal combustion engine fields on the Pacific coast is that Mr. C. C. Kriemler and Mr. Richard Froboese have formed a partnership with the purpose of manufacturing distillate engines and later on internal combustion engines to use heavy oils.

Neither of these gentlemen need any introduction to western engine users. Mr. Kriemler was with the Standard Gas Engine company for thirteen years at the head of the sales department of that concern and lately performed the functions of a general managership. His wide knowledge of the gas engine business coupled with strict business integrity has made countless friends for Mr. Kriemler up and down the coast and he carries into his new venture the good wishes and good will of both engine users and engine makers.

Mr. Richard Froboese brings a rare engineering

skill to the combination. For years he was the mechanical engineer for the Corliss and Imperial engines and later was with the Standard Gas Engine company in a similar capacity. Froboese has always been a keen student of the distillate engine and several different makes of gas engines on this coast bear the impress of niceties of design for which he is responsible.

The new firm will be known as the Acme Engine company and it is proposed to secure a plant site near San Francisco and build and equip a thoroughly up-to-date factory. Standardization of engine sizes giving a maximum of interchangeability of parts is being carefully worked out, the plans contemplating but four different cylinder bores and four different strokes in sixteen standard power units.

While we have not yet seen the plans of the new engines we understand that the cylinders are

to be cast separate, that the engine will have an enclosed base and enclosed overhead valves. The pistons can be drawn out from the bottom without removing the cylinder heads and the heads will be removable without taking down the exhaust manifold. Wherever possible, parts will be made to jig with the result that parts will not only be interchangeable in the same engine, but many of the parts will fit in several different powers of engine.

It is the intention of the firm to handle a well known four-cycle, full Diesel engine on this coast, the name of the engine, however, has not yet been divulged. In order that it may serve its marine clients in as full a manner as possible, the Acme Engine company has secured the California agency for the electric winches of the Pacific Machine Shop and Manufacturing company which have so recently secured the interest of all shipowners.

# Southwark-Harris Installation in Halibut Schooner "Comet"

AFTER considerable alterations to the hull, which includes a raised forecastle head, new deck and wheelhouse, the halibut schooner "Comet," owned by the San Juan Fishing & Packing Company of Seattle, has been equipped with a 225 b. h. p. Southwark-Harris Diesel in place of her old distillate engine of considerably less power.

The new installation has been carried out in first-class manner by the owners of the vessel and despite the limited space, the engine room presents a neat and practical appearance.

The distribution of the weights port and starboard has been carefully considered and the maximum of space obtained by keeping in view the fact that the operators of these engines must have room to move around for the examination of the entire plant.

At the forward end of the engine room, separated by a steel bulkhead and running athwartships, is the main fuel tank, which has a capacity of 4,300 gals.

In the engine room forward and on the starboard side, as will be seen in the illustration, are four air bottles 13 $\frac{3}{4}$ "x6 feet standing on end. Aft of these is the work bench hidden in the illustration by a 450-gal. fuel tank which stands in wing at the after end.

On the port side, at after end, are two smaller tanks containing 150 gals. of lubricating oil and 75 gals. of gasoline for priming auxiliary engines, exclusive of a 65-gal. service tank.

Forward of these on the same side are the auxiliaries, consisting of a 2-cylinder 12 h. p. Frisco Standard stationary, connected to a 2 $\frac{1}{2}$  k. w. General Electric motor with a 10-cell Edison storage for lighting purposes. This engine can also be connected to a Southwark-Harris auxiliary air compressor or a 2-inch Moran centrifugal pump.

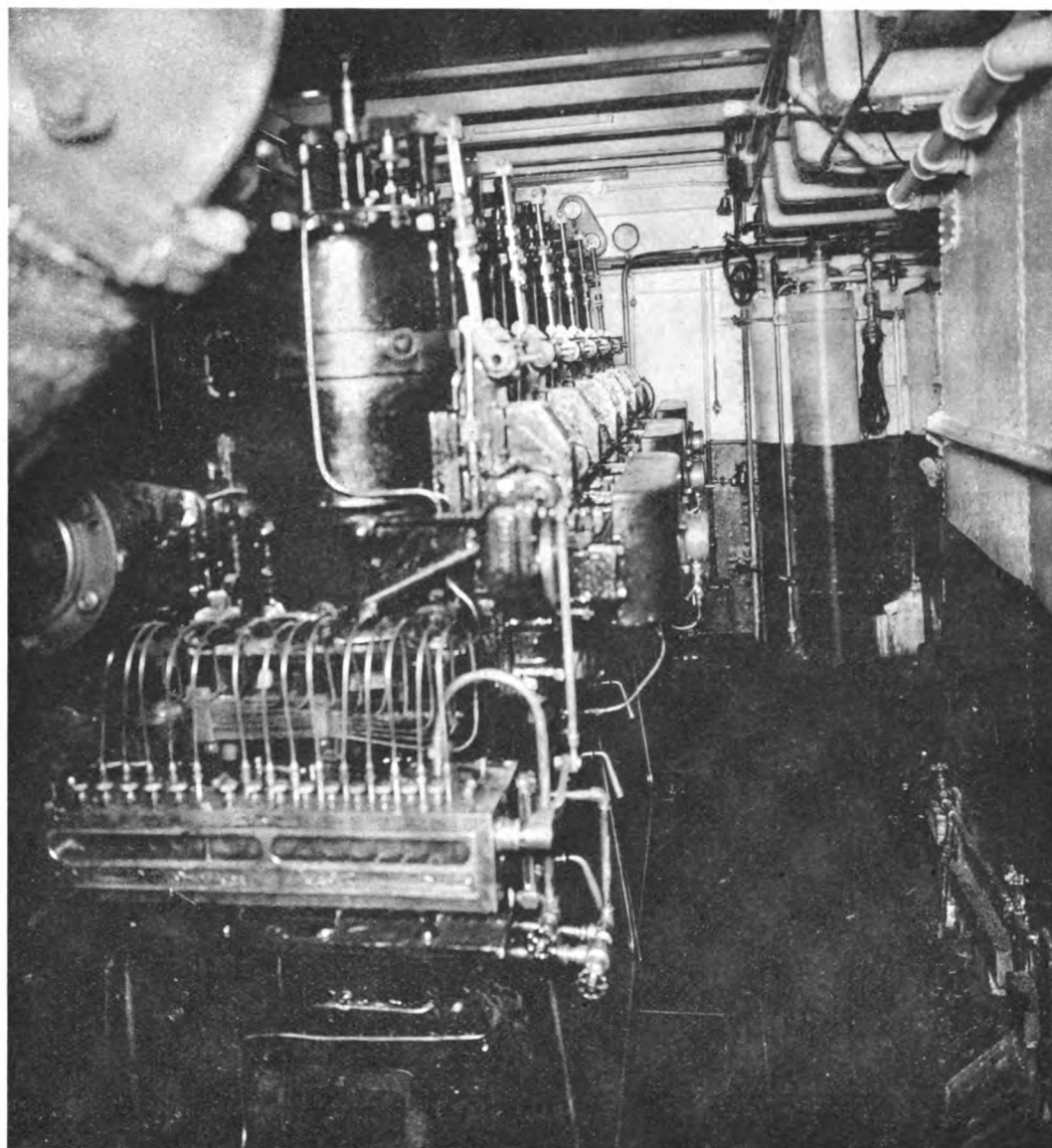
There are also two more air bottles vertically set against the forward bulkhead on port side, and two 12 $\frac{3}{4}$ -inch x 12 feet air bottles placed under the engine room floor. Four of the eight air bottles carry injection air at 900 lbs. and four starting air at 350 lbs. pressure.

The exhaust outlet is led into a substantial stack and well silenced. Whilst this engine in six cylinders of 9 by 13, with scavenging pistons of 14 inch, develops 360 i. h. p. at 300 revolutions, the owners have wisely decided upon operating it at an average of 250 r. p. m., turning a 58x56 three-bladed wheel.

Among the many features of interest on this direct reversing Diesel is the rotary direct reversing circulating pump which is positive in action. Since the engine has been installed it has been found necessary to increase the compression by placing liners between the T ends of the connecting rods and the brasses, otherwise good re-

sults could not be obtained with calol fuel oil.

The "Comet," which sailed for Ketchikan, Alaska 21st inst., (after adjusting compasses) is 94 feet over all, 19 feet 5 in. beam and draws 9 feet 6 in. loaded, having a capacity of about 120,000 lbs. of fish.



ENGINE ROOM OF "COMET," VIEW FROM AFTER END

## M. S. "Carlisle II" New Fairbanks-Morse Installation



THIS vessel described in our April issue is now operating a freight and passenger service between Lummi Island and the mainland, Washington, filling a long felt want of the residents of the district who have been somewhat isolated.

The photograph taken upon the maiden run from Seattle to Lummi Island hardly does her justice as it shows her with a heavy deckload

which put her considerably out of trim, and by the stern.

"Carlisle II" is owned by the Lummi Island Navigation company, a branch of the Carlisle Packing Co., of Seattle, of which Mr. Frank Wright is president. She is 65 feet over all and 20 feet beam. Her power equipment consists of a 75 h. p. C. O. type Fairbanks-Morse oil engine.

### NEW SKANDIA INSTALLATION.

The Skandia Engine Agency of Seattle, Wash., report the shipment of a twin set of 240 b. h. p. Skandia oil engines from their factory at San Francisco to Portland, Ore., for installation in the auxiliary motor schooner "W. F. Burrows," owned by Libby, McNeill & Libby. This vessel is now being completed by her builders, the Standifer-Clarkson Ship Yard Inc., of Portland, Ore., who will also install the engines.

The engine room auxiliaries in this vessel will include two 50 b. h. p. Skandia stationary oil engines connected to generators for supplying current for electric deck winches and windlass supplied by the Pacific Machine Shop & Manufacturing Co. of Seattle. There is also a ten h. p. Skandia stationary oil engine for driving auxiliary air compressor and bilge pumps.

### A NEW MARINE PAINT.

The Waterproof Paint company of Seattle, Wash., make the announcement (see advertisement in this issue) that they have undertaken the manufacture of a specially prepared paint (patent pending) which they claim will resist teredo, barnacles and marine growth, also it will resist corrosion when used on metal. Another desirable feature which the manufacturers claim being that their preparation will dry under water and thereby is specially adapted for ship bottoms, both wood and steel, bunkers and damp places; it is easily applied, remains elastic, and will not peel or blister.

The paint is manufactured in two colors, black and dark red, and extremely economical in cost.

The manufacturers are willing to supply either color in sufficient quantity to cover the underbody of a small vessel free of charge, preferably a commercial boat in operation around Seattle.

### MAX KUNER COMPANY IN NEW LOCATION.

The above well-known firm, which has carried on a large nautical instrument business for many years at 94 Columbia St., Seattle, will be located in their extensive new premises at 804 First Ave., Seattle, after May 1st.

# Werkspoor Diesel-Engined Motorship "Bengkalis"

THERE recently arrived in the Dutch East Indies from Europe, one of the handsomest motorships of her size ever built, and reference to the illustration will confirm this laudation. We refer to the M. S. "Bengkalis," which although only of 1,240 d. w. c., is so excellently proportioned that, when there is no background by which a comparison can be formed, she looks like a vessel of at least 4,000 tons. She is a sister-ship to the M. S. "Belongan"—also Diesel-driven, which was completed several months before by Pot Bros., of Bolnes, Holland. Both vessels are owned by the Koninklijke Paketvaart Maatschappij (Royal Packet company), and are exactly similar in dimensions and in machinery, and are used, together with half-a-dozen other Diesel motorships, among the "Javan" islands.

The "Bengkalis" is 230 ft. long between perpendiculars, with 38 ft. breadth, 13 ft. moulded depth, and displaces about 2,000 tons in a summer-freeboard loaded-draught of 11 ft. 2 ins.

The "Bengkalis" has the following dimensions:

Length B. P. ....	230 ft. 0 in.
Breadth Moulded ....	38 ft. 0 in.
Loaded Draught (Summer-freeboard) ....	11 ft. 2 in.
Displacement (as above) ....	2,000 tons.
Dead-weight capacity ....	1,240 tons.
Actual cargo capacity ....	1,100 tons.
Bunker capacity ....	106 tons.
Cruising radius ....	10,000 nautical miles.
Speed ....	8 knots (with engine developing 600 i. h. p.)
Fuel consumption (main engine only) ....	1½ tons (10½ barrels) per 24-hour day.

The owner's acceptance trials only lasted about five hours, whereupon the "Bengkalis" loaded and started on her long voyage from Rotterdam to Weltevreden, Batavia, Java, Dutch East Indies, where there are no proper facilities for the repair of Diesel engines, illustrating the implicit confidence placed by her owners in this system of propulsion. The voyage was successfully completed without anything special to record, despite the danger of submarines.

A point to which attention should be drawn is that of the large cargo capacity of the holds for a vessel of her size, and the extraordinary economy of the operation for here we have a ship carrying 1,100 tons of actual cargo at 8 knots on a consumption of less than one-half barrel of oil an hour—this of course, without counting the consumption of the auxiliaries. In addition to freight she carries twelve passengers, the cabins for whom are arranged on the port side forward of the bridge. Also worthy of record is, that, due to the large cargo-capacity for the overall size of the ship, her first cost must be considerably lower than that of a steamer of the same cargo capacity. The cargo represents 55% of the total loaded displacement.

A steamer of this size making a journey from Rotterdam to the Dutch East Indies would have

little room for cargo, as she would be loaded up with coal or oil fuel, whereas the ordinary bunker capacity of the "Bengkalis" almost is sufficient. (The distance via Cape Town is about 12,000 miles.) Other Werkspoor-Diesel motorships owned by the same line are the "Sembilan," "Loudon," "Mijer" ("Meyer") and "Siberg," one of which they have had in operation for six years. The repair bill of the "Sembilan" only came to a total of \$2,400 for the first three years of operation. The others even have better records, illustrating how reliable motorships can be when in good hands.

We stated that the fuel consumption of the main engine was 10½ barrels per 24-hour day. This figures out at twenty miles cruising at full speed on one barrel of fuel-oil, or 0.05 barrels per mile (1/20 of a barrel). With fuel at \$1.50 per barrel this must mean a fuel-bill of 7½ cents per mile. The auxiliaries we will refer to presently.

A few details regarding the installation of machinery are well worth recording. This was constructed by the Netherlands Engineering Works of Amsterdam, builders of the Werkspoor-Diesel engine. The main engine is a six-cylinder direct-reversible crude-oil motor of the four-cycle type, and is built with crossheads and guides. The following are its leading dimensions.

Rated brake horse-power .....	475
Rated indicated horse-power .....	635
Normal speed .....	170 revs. per min.
Bore .....	400 mm. (15¾ in.)
Stroke .....	700 mm. (27¾ in.)
Mean indicated pressure .....	90.5 lbs. per sq. in.
Cylinder compression .....	about 450 lbs. per sq. in.
Height .....	12 ft. 5½ in.
Length .....	21 ft. 6¼ in.
Width O. A. ....	6 ft. 6¾ in.
Net weight (including compressor) ...	60 tons (134,000 lbs.)

It is a very powerful engine for its bore, stroke, and consumption, as will be understood by the size of the ocean-going ship that it drives, and its slow speed allows of a very large and efficient wheel (somewhere about 9 ft. diameter) consequently great efficiency is obtained. Also it is an engine that will run at full load for 20, 30 and 40 days at sea in storm and calm without stopping, which a light, higher speed motor could not very well do when driving a big ship. Driving a vessel like the "Bengkalis" into the teeth of a gale is an exceedingly severe strain upon the engine, and calls for substantial construction. At 180 r. p. m. the power developed is 650 indicated-horse-power.

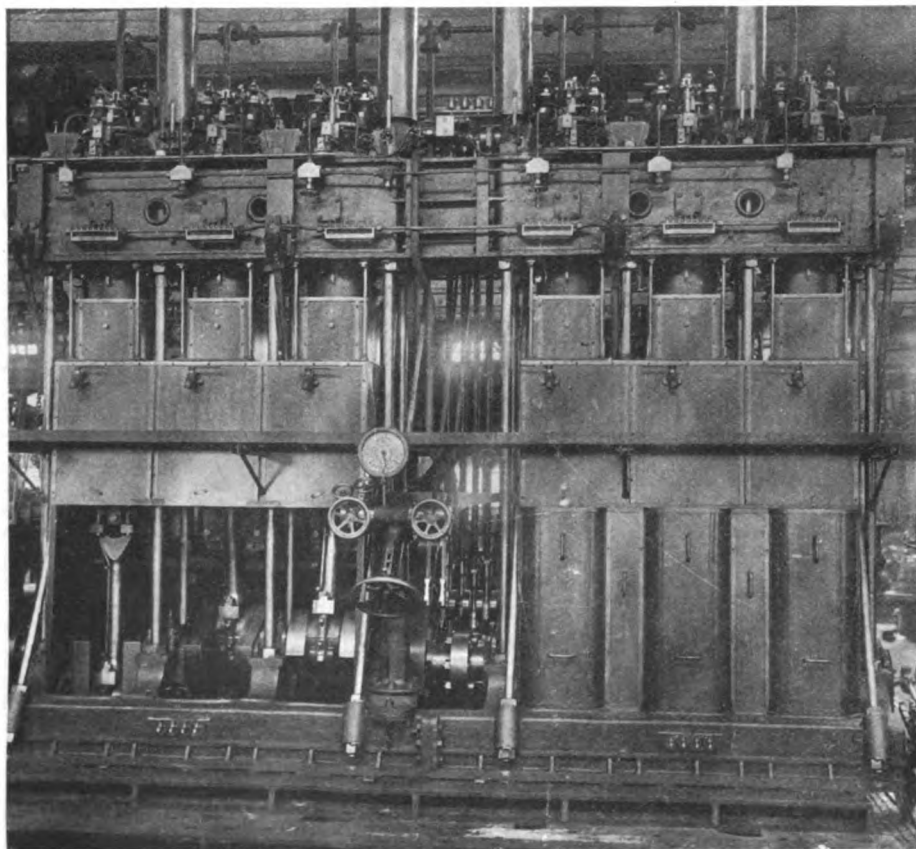
The Werkspoor-Diesel engine of the "Bengkalis" follows steam-practice, so all that new engineers have to learn is the operation of the mechanism from the lower end of the cylinders upwards—the other parts they already are familiar with. Accessibility has been brought to an unusual condition by reason of it being quite of the open crank-pit type, with the cylinders mounted on steel columns, etc., while strength and rigidity are added by steel cross-stays, with the crosshead guides on cast-iron frames at the back of the engine. To the steel columns detachable steel plates are fitted to prevent lubricating-oil being thrown out by the rods. The six working-cylinders are divided into two sets of three, with the camshaft driving-gear and all the control levers between.

The cast-iron columns at the back of the engine are not bolted to the cylinders, but have a sliding-surface fit. Their chief function is to carry the crosshead guides, and the bearings for the beam levers of the air-compressors, and cooling-pump. Being hollow, some are used as inter-coolers for the air compressors.

The cylinder proper is separate from the outer jacket, which is a simple box-casting that virtually forms a tank into which the cylinders are dropped and secured in position by studs. This method enables the cylinder liner to be cast integral with its head, and is the only four-cycle Diesel design whereby there is complete circulation of water round the upper part of the sides of the combustion chamber as well as on top. This gives water cooling exactly where it is needed, because it is there that the greatest center of heat occurs. Hence, cracked cylinders, or heads, are entirely eliminated in this design. With detachable heads it is necessary to have heavy flanges at this point, and where there is such solid metal the water cannot flow to cool the metal and thus absorb the surplus heat, so Werkspoor do not use detachable heads. By off-setting the fuel-valve, at least four inches of water space is made around each valve in the Werkspoor design.

An important part of the design is that the portion of the cylinder which extends below the jacket is detachable, and may be unbolted, thus facilitating the easy removal of any piston without dismantling any portion of the engine, and so saving many hours of tedious labor. Being under 16" diameter, the pistons are air-cooled, so that the bother of water-cooling is avoided, simplifying the engine.

The advantages of this piston-dismantling device shown, is particularly felt when a low-grade of fuel-oil is being used, because after about twenty days steady running at full power it becomes extremely advisable, and sometimes imperative, to remove the pistons and clear the rings of the carbonaceous deposit, which, if not cleaned, causes the rings to stick and thus results in loss of power, etc. With this device a piston can be taken out, cleaned and replaced, in 1½ to 2 hours,



FRONT VIEW OF THE WERKSPOOR 635 I. H. P. REVERSIBLE DIESEL OF THE "BENGKALIS"  
(B. H. P. 475 AT 170 R. P. M.)

whereas with any other design of large crosshead engine it takes 12 to 20 hours to remove and replace the cylinder-head, valve-mechanism, piston and piping.

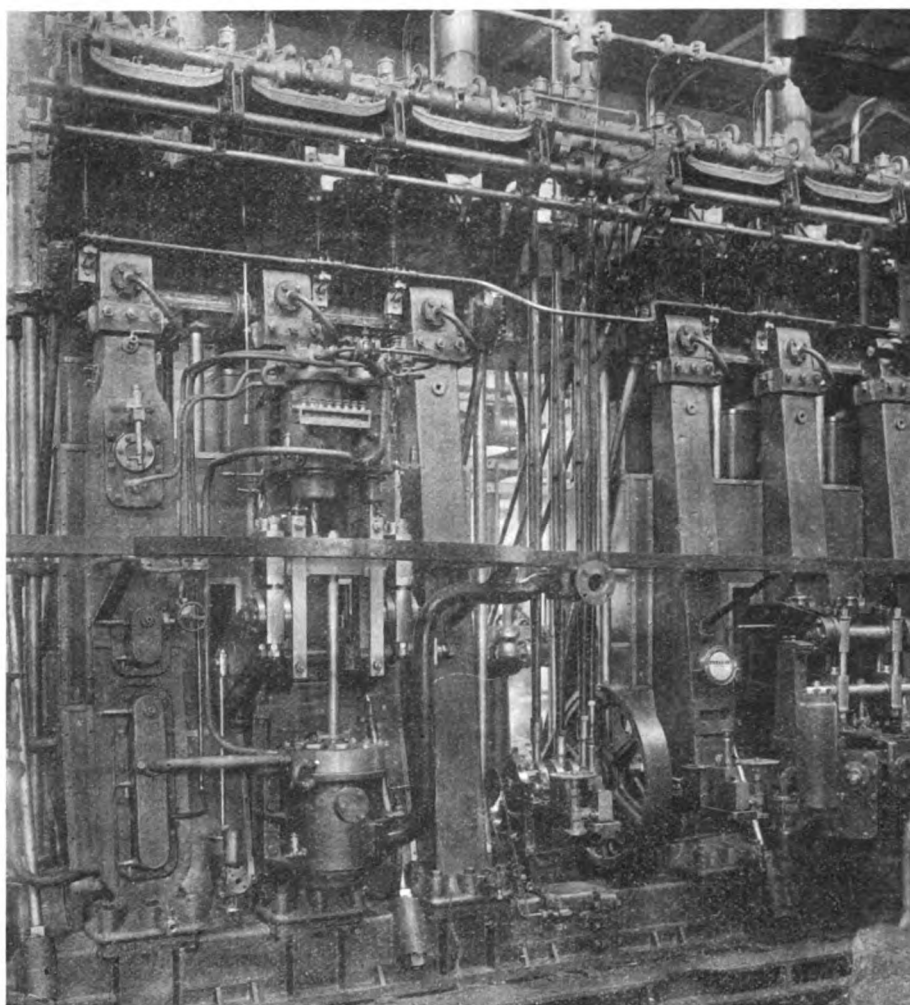
Seeing that there are twelve cylinders in the "Bengalis" and twenty-four cylinders in most ships, it is easy to understand what the Werkspoor design means to the owner, apart from easing the engineers' burden and making him more contented.

Directly on the main engine at the back, are arranged the three stage air-compressor, the cooling-pump, two bilge-pumps, lubricating pump, and fuel pump, so that the engine is self-contained. Control of the engine is by hand-wheels, whereas other Werkspoor motors have levers for this purpose.

For the purpose of operating the auxiliaries, which are steam driven, there is a Scotch boiler of 775 sq. ft. heating-surface, with a working pressure of 160 lbs. per sq. inch. It is 9' 4" long by 9' by 8" diameter, and has two furnaces arranged for liquid fuel.

The auxiliary air-compressor is of about 70 h. p., and was built by Alley & McLellan, and is arranged in the thrust-block recess on the port side. On the starboard side of the engine are two air-reservoir tanks, for air starting, and these are kept charged to 18 atmospheric pressure. Close by are a spare fuel-pump, and two spare fuel-pumps for the boiler. On the other side of the engine-room are arranged two Weir boiler-feed pumps, a condenser of 320 sq. ft. cooling surface, two ballast pumps, and one evaporator. At the top of the engine-room is installed the steam-steering gear. All these auxiliaries as well as the deck-winch are steam-driven from the donkey-boiler.

Regarding the ship, the engine-room is arranged amidship. Already we have referred to the passenger accommodation on the port side. To the starboard are the accommodations for the stewards, clerks, and cooks, an office for the chief engineer. On the bridge-deck is the passengers' dining-saloon, while on the flying-bridge are the captain's cabin and the chart-room. Accommodations for the officers and engineers are in the poop, while the native crew have the forecabin. There is a fore-peak tank of 40 tons, and an after-peak tank of 25 tons, but no double bottom, except under the engine-room, where the fresh water for the boiler and 40 tons of fuel are carried. The remaining two fuel bunkers are in the wings and are of 28 tons capacity each, so altogether 106 tons of fuel are carried, which is sufficient for a



BACK VIEW OF THE WERKSPOOR ENGINE OF THE "BENGALIS"  
Showing air-compressor in three stages, cast iron guide columns, right, double cooling water and bilge pump, also camshaft-driving split-steel tubes operating in tension at center

very long voyage, say, about 50 days. When, by the way, 8 knots is developed on a consumption (main engine) of 10½ barrels of oil per 24 hour day, the indicated-horse-power is 600, so that the full-power consumption is a fraction in excess of this.

Vessels of this design would form ideal cargo carriers for breaking the submarine-blockade, and the Shipping Board would do well to look closely into the question. Because of their small size they could be built quickly even in steel, and would standardize excellently.

#### LARGE BRITISH SUBMARINE

Reference was made in the April Motorship to the 5,000 i. h. p. steam turbine-driven-submarine that Scotts were said to have commenced construction several years ago. What is practically a confirmation of this statement was published in a recent issue of the New York Sun, as follows:

"The latest thing in submersibles turned out in British yards is a turbine-driven 'submarine-destroyer.' This marvel mounts extremely heavy guns for a submersible and can do better than twenty-one knots on the surface.

"The first vessel of this type was commanded by Capt. Hardy. On her trial trip something went wrong with her valves and she went to the bottom. The entire crew, more than thirty men, was drowned, Capt. Hardy being the only survivor. He was blown out of the conning tower, with Commander Goodhart of the British navy, and rose to the surface. Two fingers were torn from his right hand. Commander Goodhart was drowned.

"The submersible destroyer was raised and subsequently went through her trials successfully with Capt. Hardy again in command."

We think, however, that the Sun is mistaken in the purpose of this vessel, and that she is intended to be a large ocean-going submarine—not a submarine-destroyer, as submersibles are almost of no use for seeking, attacking, and destroying each other, they not being nearly so suitable for the work as are fast surface craft.

#### AUGUST MIETZ CORPORATION, NEW YORK.

It is officially announced that the business of August Metz, Emma C. Rueff, proprietress, has been sold and transferred to August Metz Corporation. The officers of the new corporation are: Emma C. Rueff, president; Emil Rueff, vice-president and treasurer; Otto V. Schrenk, secretary and Louis C. Eitzen, general manager.

The business will be continued under the corporate form of organization, at the same address,

128-138 Mott St., New York, and without any change in its policy, under the personal management of Mr. Louis C. Eitzen. Dated, New York, April 5th, 1917.

#### SEATTLE PLANT BUILDS SUMNER ENGINES.

The Marine Pipe & Machine Works, Inc., of 579 Railroad Ave., Seattle, Wash., have commenced work upon three twin sets of 350 b. h. p. Sumner marine oil engines to the order of the H. W. Sumner Co. of Seattle. The engines are to be installed in the three standard Grays Harbor five-masted schooners now in course of construction at the Grays Harbor Shipbuilding Co.'s yard at Aberdeen, Wash.

#### NEW VESSEL FOR LIBBY, McNEILL & LIBBY.

The keel for a five-mast bald-headed auxiliary motor schooner, to the order of the above company, has been laid at the yards of the Standifer-Clarkson Shipbuilding Co., Portland, Ore. The hull is of the 'tween deck type and of the following dimensions, 240 feet over all, 44 feet beam and 23 feet moulded depth. A twin set of oil engines will be installed, the make of which has not yet been decided upon. The vessel is intended for use in connection with the Libby, McNeill & Libby canneries.

### Submarine Engines of the World at a Glance

Name—	Country	Cycle	Brake H. P.	No. of Cyls.	Bore (Ins.)	Stroke (Ins.)	Speed (R.P.M.)	Weight (Tons)	Weight per B. H. P. (Lbs.)	Piston—Speed per Min.	H. P. per Cyl.
Augsburg.....	Germany	4	900	6	15.7	15.7	450	....	....	1177.5 ft.	150
Busch-Sulzer.....	U. S. A.	2	600	6	12.2	11.8	400	....	....	786.6 ft.	100
Craig.....	U. S. A.	4	300	6	12.5	15.0	300	....	....	750.0 ft.	50
F. I. A. T.....	Italy	2	1,300	6	....	....	400	25	43	....	217
Krupp.....	Germany	2	1,000	6	13.7	15.7	425	18	40½	1112.1 ft.	166
Loire.....	France	4	420	6	....	....	400	....	....	....	70
Niseco.....	U. S. A.	4	600	8	....	....	450	....	....	....	75
Nobel.....	Russia	4	180	6	8.8	11.8	500	2	30	983.3 ft.	30
Nobel.....	Russia	4	1,200	6	....	....	400	....	....	....	200
Normand.....	France	4	420	6	13.0	14.2	400	18½	99	946.6 ft.	70
Nürnberg.....	Germany	2	900	8	12.0	13.3	450	....	....	997.5 ft.	112
Polar.....	Sweden	4	350	6	11.4	11.75	300	16½	172	587.5 ft.	70
Sabathe.....	France	4	500	6	13.75	13.75	400	14½	60	916.6 ft.	83
Sabathe.....	France	2	700	8	12.25	15.75	310	22½	72	813.7 ft.	87
Sabathe.....	France	2	500	6	12.25	15.75	310	14½	66	813.7 ft.	82
Schneider.....	France	2	2,400	8	18.5	....	....	....	....	....	300
Schneider.....	France	2	1,100	8	13.0	14.5	400	....	....	966.6 ft.	138
Schneider.....	France	4	360	8	12.0	11.0	400	....	....	733.3 ft.	45
Southwark-Harris.....	U. S. A.	2	550	6	12.0	14.0	375	19½	80	875.0 ft.	91
Sulzer.....	Switzerland	2	600	6	12.2	11.8	400	....	....	786.6 ft.	100
Vickers.....	England	4	1,800	12	....	....	400	....	....	....	150
Werkspoor.....	Holland	4	550	6	....	....	450	12	49	....	91
Werkspoor.....	Holland	4	450	6	14.2	14.2	400	11	61	946.6 ft.	75
Werkspoor.....	Holland	4	240	..	....	....	450	4½	42	....	...

In the April issue of Motorship illustrations and technical details of all the leading makes of submarine Diesel engines in the world were published. We now give above their general details in tabulated form, from which most interesting information can be obtained. For instance, from the weights per b. h. p., it will be seen that some of the 4-cycle engines are lighter than the 2-cycle motor, which is contrary to the general belief. The weights of the various motors range from 30 lbs. to 172 lbs. per b. h. p. developed. The highest rated power per cylinder yet obtained is 300 b. h. p. Altogether 6 makes of engines can develop over 150 b. h. p. per cylinder. In all cases we have made every endeavor to ensure accuracy, but in some instances, such as the Vickers, we have been unable to verify the figures.

# MOTORSHIP

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## AWAKE, AMERICA!

### British Government Building Standardized Motorships.

It has been widely known for some little time past that the British Government had arranged for the construction of over 100 standardized steel cargo ships of 3,000, 5,000, and 8,000 tons with more to follow, and that 50 of these were under construction by Mar. 22nd; but it is not generally known that a large number of these vessels are to be motorships; thus, not only will they make an enormous difference to the economy of fuel, but will have a much greater combined carrying capacity, than would steamers of the same dimensions. Hence an economy also is effected in the building yards, and steel mills, because to have the same carrying capacity at least ten more steam ships would have to be built. Fuel also would have had to be supplied for this additional number. We understand that all the 3,000 and 5,000 ton vessels will be motorships.

Replying to Admiral Lord Chas. Beresford on behalf of the British Government, on April 26th Lord Lytton stated that:

"the construction of standardized Motorships is proceeding as fast as the material available allows."

### HOW LONG WILL THE PRESENT MARKET LAST?

#### Is It Advisable to "Wait and See," or to Boldly Order Motor Vessels With Delivery Several Years Hence?

A CONSIDERABLE number of domestic shipowners have recognized the advantages of motorships; but lengthy deliveries have raised serious doubts in their minds as to the advisability of placing further orders at this time, and they prefer to wait and see how long the war lasts; in other words—they are nervous that a sudden cessation of hostilities will cause a shipping slump together with a simultaneous drop in freight rates. Quite recently one shipowning concern advised the writer that they do not know what to do regarding the ordering of ships just now, and that while they certainly need them, there are so many coming into the market that they cannot help feeling that as soon as the war is over there will be so many ships that there will not be business enough to take care of them. They feel positively that ships are going to be bought at very low prices within a short time.

It was a similar attitude adopted by shipowners throughout the United States that enabled Norwegians to step in a year or two ago and book almost the entire outputs of some American shipyards, with the results that American shipowners afterwards were obliged to step in and purchase

these American-built ships at abnormal prices. Enormous profits must have been made by these far-sighted Norwegians; and, until we boldly prepare for future commerce by ordering motorships with deliveries three, four, five, and six years ahead the United States will never rank the highest in merchant marine fleets. Today is the opportunity and Diesel-driven vessels should be ordered to cover the future, thus following the example of several of the great European companies, who have ordered steel Diesel-driven motorships for delivery in four, five, and even six years' time.

Let us sum up the situation in an intelligent manner, and see if shipowners are warranted in taking what apparently is a bold, if not risky, step:

(A) For two to three years after the war the goods to be shipped will exceed the quantity previous to the war. Europe has to be rebuilt. Trades and industries now almost dormant will be revived when the great armies return to their normal occupations.

(B) Even with all the shipyards now active the world's pre-war tonnage cannot be equalled by new constructions for at least three years—even if Germany sinks no more ships; and the inclusion of Germany's existing merchant ships will be a comparatively small item.

(C) We can be certain that Germany will sink at least 500 additional merchant vessels, or, say, 2,000,000 tons, if not more, before she is defeated. She now can sink American ships with impunity.

(D) It is impossible for a shipping "slump" to come for at least three years, even if peace was declared in a month, except a temporary market panic, which would quickly adjust itself and then re-act.

(E) If the Shipping Board builds a thousand new wooden ships (we doubt if more than 150 will be in service within one year from now (i. e. the time of writing) if power driven) the "rush" conditions under which they will be built will limit their practical ocean-going life to more than several years, and their eventual abandonment will cause maintenance of freight rates, apart from losses through sinking by German submarines.

(F) Many steel ships at present in service are old craft "doctored up," and they now are receiving such severe wear that they will almost be worthless in a few years' time. At present they are carrying a substantial amount of cargo, and when no longer insurable at Lloyds, their loss will be severely felt in the carrying market.

(G) Some of the motor auxiliaries recently built, and under construction, in America are giving trouble, or will give trouble, respectively, due to bad installation-work, faulty hull-design, and in a few cases to badly designed and poorly constructed machinery caused by lack of proper ocean-going experience of the engine builders. Changes will have to be made in many cases that will cause them to be laid-up for a period, meanwhile freights will congest at wharves and terminals. This, we believe, also, may happen to many of the wooden ships to be built by the Government, especially if the constructions are "rushed" too quickly.

(H) Should a slump eventually come, owners of Diesel-driven motorships will be in excellent positions, because their vessels will carry hundreds of tons more cargo and will be operated at one-third the cost, of the similar sized steamers now in the services of steamship owners. Hence, size for size, motorships will have a much greater market value than steamers, and will be run at a profit where steamers will have to be laid up.

(I) Steel shipyards all over the world now are crowded with orders for merchant ships (mostly steamers) and can take no orders for less than two to three years' delivery. Yet when all these vessels are afloat there will not be sufficient to properly handle the world's commerce. Many

ships now building would have been built even if the war had never occurred. In fact, Great Britain's war output of ships has been much lower than that of normal times, which tends to even up the effect on the world's tonnage of America's present abnormal output.

(J) Until the ships now building actually are afloat it is difficult to see how freight rates or ship values can drop, in fact, they more likely will be increased. Many of these ships will be months behind in delivery, because of labor and material difficulties, so a number will not be ready for service until three years hence. Also, seventy per cent of the output of America's largest shipyards is devoted exclusively to rushing naval work.

(K) Consequently a wooden motorship ordered now for 12, 15 or 18 months delivery cannot possibly be reduced in value by the time she is ready to go into commission, if she be of good construction and equipped with reliable engines. As the owner does not complete the payments until she passes her trials the investment must be a sound one, peace or no peace. A motorship delivered in 18 months will earn her total cost several times over before freight rates seriously become affected. Also a steel motorship ordered for three or four years' delivery will be worth far more than its present purchase price. We know where they can be obtained in two years.

(L) A temporary slump, or rather panicky drop in prices and freight rates may come if peace is suddenly declared; but it could not last more than a month or two, and the market would again swing to the high level. Those who "hold tight" would benefit.

(M) Great Britain now has comparatively little export trade. After the war all her industries, men, factories, etc., now engaged in war-work will at once be devoted to commercial goods, and her exports will soon be greater than in pre-war times. Consequently all her ships, now carrying American products to Europe, will be carrying British goods to every quarter of the globe. Then there will be insufficient American ships to carry American goods, and this will tend to maintain high freight rates.

(N) Germany most probably will be barred from extensively participating in world-wide trade after the war, as most likely this will be one of the penalties imposed upon her by the Allies, and it is even doubtful if she will be wealthy enough to build large numbers of new mercantile ships for several years to come. She may even have to pay "ship for ship" for tonnage ruthlessly sunk.

(O) It is not improbable that, if the submarine menace is checked, Germany's entire navy will make a bold dash for the open sea, and then disperse to all parts of the world, and sink all merchant ships on sight, until all her warships are sunk or captured. It would take many months, possibly years, to separately capture all her warships, which would keep the seas on fuel and food taken from captured freighters. Germany realizes that, as a last resource, this will be better than engaging in a hopeless "grand battle" with the Allied fleet. In such an event one can easily anticipate the demand for a large number of motor-vessels that can cross the ocean without any betraying smoke to render them an easy prey to the raiders.

True, the British fleet is keeping itself intact to prevent such a dash, and doubtless many German ships would be sunk; but the majority would escape because they would disperse in all directions, which the Allied fleets dare not do, so the task of hunting the individual enemy ships would be slow work. While the German raiders were at sea the damage done doubtless would far exceed that done by submarines, as indicated by the remarkable work of the solitary raider "Moewe." Thus, we can imagine the results of a hundred, or two hundred, German warships distributed all over the world's seas, and the terrible effect upon commerce. Germany is holding back her fleet for a final and awe-inspiring feat—and, it will not be a fool-hardy attack on the British fleet, unless intercepted in its dash for the open ocean. We can look forward to this move as a certainty, so that the wise shipowner will prepare for the future.

# Semi-Diesel, Surface Ignition or Hot Bulb?

By W. B. Slaughter, Jr., Mech. Eng. and Supt., Marine Mechanical Works, San Pedro, Cal.

IN an interesting series of articles entitled "Oil Engine Nomenclature," appearing in *Motorship*, the burden of proof seems to have been to show that the term "Semi-Diesel," as applied to a certain type of oil burning internal combustion engines, is a misnomer and an unpardonable encroachment upon the domain and rights of the Diesel engine. Various methods were proposed for determining when the term Diesel can be applied to an engine, in all of which some truth is to be found but in none of which has the real secret been dwelt upon.

The correct way to judge a Diesel engine, or any engine in fact, is by its cycle of operation or by its indicator card. The successive steps of the Diesel cycle or card may be defined as: first, adiabatic compression; second, slow burning at approximately constant pressure, and third, adiabatic expansion. It seems reasonable that any number of mechanical devices and methods can be designed and used which will give us the required cycle, and for this reason it is incorrect to attempt to define a Diesel engine by any of its mechanical appurtenances and auxiliaries. For instance, fuel may be injected into the cylinder by means of compressed air, by a mechanical pump, or let into the cylinder by gravity into a cup (as per the Brons patents) whence an auxiliary explosion diffuses the charge; but if the indicator card of the engine shows that the cycle of operation is the same as the Brayton or Diesel cycle, we have a Diesel engine. Thus, it is the card and not the method of fuel injection which determines the type of engine. It is well known that in some of Dr. Diesel's first designs he did not use auxiliary air injection, yet they were of true Diesel type because of the nature of their cycle. In fact, his first engine, (and it was a true Diesel) was designed to burn coal dust, we are informed. Therefore, it would be incorrect to specify an air compressor and air injection as necessary to allow an engine to be called a Diesel. Likewise, I believe that the same reasoning carried to its logical end would lead us to the conclusion that it is incorrect to demand any particular method of fuel injection or any particular mechanical devices as fundamental in Diesel engines.

Now it would seem that the status of the Semi-Diesel, Surface Ignition, or Hot Bulb engine should be determined in the same manner as we determine whether or not any particular engine deserves the title of Diesel. If we examine the card of a good semi-Diesel engine, we will notice at once that we have a compromise between the Otto cycle and the Brayton or Diesel cycle. Figure 1 shows a diagram representing the Diesel cycle. Note its compression line, a-b, the absence of sudden increase of pressure due to ignition. Note also its horizontal constant-pressure line, b-c. Figure 2 shows a diagram representing the Otto cycle, used by distillate and gasoline burning engines. In this connection, note its relatively low compression line, e-f, the long vertical line of suddenly increased pressure, f-g and the low expansion line, g-h. Figure 3 represents the cycle followed by the Simplex oil engine made by the Marine Mechanical Works of San Pedro, Cal. This engine is representative of the more advanced designs of the type preferably called semi-Diesel, by some called Surface Ignition, and slurringly referred to by others as Hot Bulb. It is at once very apparent that there is a compromise between the two cycles previously illustrated. Note the compression line, i-j, which is higher than the Otto and lower than the Diesel. Note the relatively short vertical line of suddenly increased pressure, j-k. Notice particularly how much more like the Diesel cycle it is than the Otto in general appearance and proportion. It should be very evident that this is a compromise and none but those who may be jealous of the word "Diesel" should criticize the right to call the third diagram that of a "Semi-Diesel" engine.

In the modern engines of this disputed type, the necessary temperature for the ignition of the fuel is derived not from the heat of compression nor from the temperature of the hot surface alone, but from the combination or sum of the two. To show that the temperature of the hot surface of the Simplex oil engine, for instance, could not cause the ignition, it is only necessary to state that one can touch the so-called hot bulb with his bare hand, when the engine has run for hours, without danger of burning himself. This fact

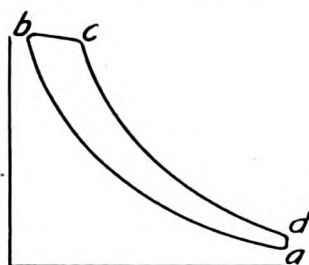


Fig 1

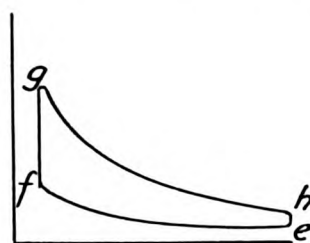


Fig II

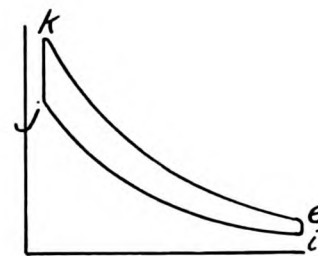


Fig. III

would lead one to believe that the term, Surface Ignition, as applied to these engines is a misnomer and that the term, Semi-Diesel, conveys more integrity of meaning.

To go farther, it has been stated by some that the "so-called semi-Diesel" is nothing more nor less than the old hot bulb engine masquerading under a new name. Here too, we can revert to our cards and diagrams of fundamental cycles. The old hot bulb engine operates according to the Otto cycle purely and simply, as in the case of the Hornsby-Akroyde engine. The hot bulb is merely a feature making an engine which operates according to the Otto cycle self-igniting, and its card differs in no wise from that of an electrically ignited engine. This thoroughly refutes and disproves the charge that the "so-called semi-Diesel" is a misnomer for the old hot bulb type of engine.

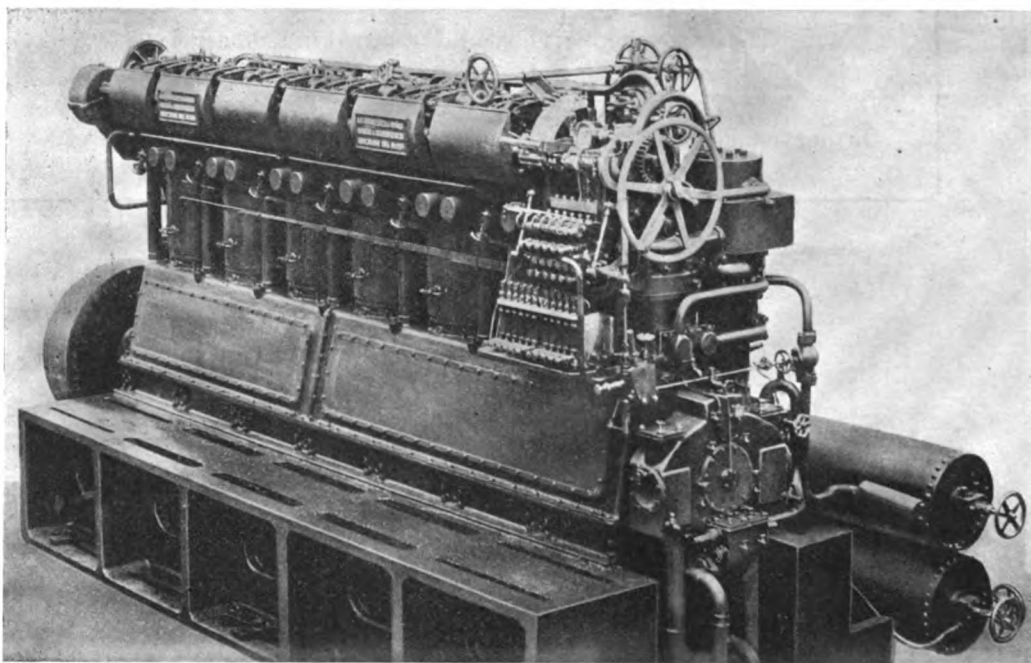
Finally, the term semi-Diesel is one that has

been recognized by men in this field for some time, and one which is objected to by none but those who build Diesel-type engines exclusively. Lionel Marks, editor-in-chief of the *Mechanical Engineer's Hand Book* and Professor of Mechanical Engineering at Harvard University and Massachusetts Institute of Technology, uses the term without reservation. It is a term universally recognized in England and on the continent of Europe, and is used without apology by Giorgio Supino, the brilliant Italian engineer and collaborator of Dr. Diesel, in his wonderful new book, "Land and Marine Diesel Engines."

It is well to define and be exact in our nomenclature, but we should be fair minded as well. The Diesel is a truly wonderful engine and deserving of all praise; likewise, so is the semi-Diesel. Each type carries with it its own peculiar advantages and disadvantages, and each is more suitable for some fields than the other.

## Danish Submarine Diesel Type Engine

By J. C. Shaw.



BURMEISTER AND WAIN FOUR-CYCLE SUBMARINE DIESEL ENGINE

IN the article on Submarine Diesel Engines, appearing in last month's issue of *Motorship*, a very interesting engine of Danish origin was omitted. This is being built by Burmeister & Wain, of Copenhagen, who are well known for their application of Diesel motors for large merchant vessels.

The first set of these engines was completed a year and a half ago, a view of one being shown on test stand in the accompanying photograph. It operates on the four-stroke cycle and has the same essential features of design as embodied in their slow speed main engines and auxiliary engines as employed in cargo vessels.

The engine has six cylinders of a bore and stroke of 330 m. m. (13 inches) and is rated at 450 b. h. p. at 500 r. p. m. The length over fly-wheel is 14 ft. 6 ins., and the height above crank center and rocker arms is 6 ft. 2 ins. The weight is 19,800 lbs., with accessories, or about 44 lbs. per b. h. p.

The engine was designed and tested out in competition with a well-known two-cycle German engine of the same power for the same class of submarine with interesting results. The breadth and length of the two engines are the same with the height somewhat less for the four-cycle. The saving in weight over the German engine is 1½ tons.

Comparing the fuel consumptions, the four-cycle showed a saving of 18% at full power and 24% at 10 knots condition. The consumptions per b. h. p. (metric) for various powers are as follows:

Power	4-cycle	2-cycle
100%	192 gr.	234 gr.
50%	203 gr.	258 gr.
25%	234 gr.	320 gr.

This confirms what other builders have arrived at recently regarding the superiority of the four-cycle over the two-cycle for submarine work.

# Geared-Turbine or Diesel-Driven Tankers

## A Discussion of Particular Interest to Oil Companies

WHEN one takes into consideration the great benefits that would be derived by the various American oil companies if all coal-burning freight vessels up to 12,000 tons d. w. c. were converted to motor power it becomes difficult to understand why only one oil-concern in the U. S. A. has encouraged shipowners to take such steps by themselves ordering large ocean-going motor tankships for their own transportation work. One or two other domestic oil companies have shown a tendency to do something of this nature, but their attempts were only half-hearted, and they did not offer the proper co-operation to the shipbuilders. Their proposals seemed to lack the real spirit and definite action, consequently nothing was done. The Gulf Refining Co., who, by the way, made millions of dollars profit during the past financial year, did have a 1,400 i. h. p. Diesel-driven vessel designed for them, but the matter has gone no further. Surely such wealthy companies can afford to set aside half-a-million apiece for producing a successful Diesel-driven motorship. Even supposing the first ship was not successful and had to have \$20,000 or so, spent on repairs and alterations, the economies otherwise effected would still leave them with a credit balance, and subsequent ships would bring greater profits. Today, however, there is no reason why large Diesel-driven tankers cannot be built that will need no repairs or alterations—in fact such vessels are in constant service. But this matter is mentioned in order to demonstrate that the thought of the possibilities of owning what may be a non-successful craft should not be allowed to stand in the light.

Engineers have produced in an unusually short time a new and remarkable economical method of propulsion, and it is most disheartening for those engineers to have some shipowners casting every aspersion possible upon this invention or uttering caustic remarks about its weak features; in fact, unwittingly throwing every available obstacle in the way of its development, instead of co-operating with Diesel engine builders by doing everything possible to assist its development, and by accepting short-comings of the past in the proper progressive spirit. The opposition and prejudice is even greater than the steam engineers of a century ago had to face, which hardly is conceivable in these modern days. Yet to a considerable extent the failure of many such motor vessels as have been unsuccessful has been due to shipowners themselves, or to their advisers, because they failed to use, or had not the means of using, proper judgment. Shipowners and oil companies will benefit by the adoption of motorships, so an aggressive attitude is distinctly against their own interests.

A few weeks ago the writer was conversing with the president of one of America's most important shipping lines, who own a large British built Diesel vessel, which happened to be the first motor vessel turned out by the builders, and naturally is not the acme of perfection, although the service she has been giving during the last three years has not been so bad. Yet when this president was asked if they proposed to order additional motorships, his verbatim reply was, "I do not wish to discuss the subject; we have one motorship and wish we hadn't." The attitude of this shipowner will give a comprehensive idea of what Diesel engine builders have to contend with. If he reads this he possibly may recognize that his attitude hardly demonstrates the true spirit of progress. This was an actual instance and not newspaper fiction. They had, it is understood, some trouble in the earlier days with this ship; but she now appears to be doing very well indeed.

Shipowners also will do well to remember that the cost has been enormous to steam-engine builders who have had to reorganize their shops in order to construct Diesel engines, and so the utmost co-operation should be extended to them. Today American shipowners are more wealthy than they ever have been, and can afford to take the risk of non-success of the first motorships—and this risk depends very largely upon the amount of discrimination shown by themselves when placing orders. It only is necessary for them to follow the path of the most successful vessels to obtain success for themselves. The engineer question also is one that rests entirely with the shipowner, and we have clearly indicated

in previous issues how this can permanently be answered.

We are enabled to give some very interesting comparison figures between an oil-fired steam-driven tanker and a Diesel propelled tank motorship actually in service between the U. S. A. and Europe. The approximate figures for the steamer were provided by Mr. Theodore Ferris, the well-known New York naval architect, to whose courtesy in checking this article we are indebted.

The leading dimensions of the two vessels are herewith given and both carry approximately 2,000,000 gallons of oil cargo in their holds.

Hull.	Steam.	Motor.
Carrying capacity .....	2,000,000 gals.	2,000,000 gals.
Displacement (loaded) .....	11,075 tons	10,250 tons
Speed at sea (average) .....	11 1/2 knots	11 1/2 knots
Length .....	390' 0"	390' 6"
Breadth .....	52' 0"	51' 0"
Depth .....	31' 0"	29' 0"
Load draught .....	25' 7"	23' 5 1/2"
Bunker-fuel required for N. Y.-London-N. Y. ....	680 tons	250 tons
Boiler water carried .....	150 tons	80 tons
Drinking water .....	40 tons	40 tons
Stores .....	30 tons	30 tons
Crew and effects .....	5 tons	5 tons
Dead-weight-capacity .....	7,450 tons	7,045 tons
Amount of cargo in holds with oil round 22 gravity. ....	6,700 tons	6,700 tons
Machinery and fuel-tank space .....	60' 0"	45' 0"
Average indicated h. p. developed .....	2,400	2,650
Maximum indicated h. p. advisable .....	2,900	2,720
Average shaft h. p. ....	2,160	2,040
Maximum shaft h. p., advisable .....	2,600	2,200
Average revolutions per minute .....	80	110
Weight of machinery (steam up) .....	540 tons	350 tons
Weight of main engines and compressors .....		244 tons
Length of main engines .....		27' 3"
Fuel consumption, including auxiliaries at sea per 24 hrs. ....	28 tons (196 bbls.)	9 tons (63 bbls.)
Daily mileage .....	276 nautical miles	276 nautical miles
Fuel used per round voyage of 6,800 miles (at sea only) .....	680 tons (4,900 bbls.)	225 tons (1,575 bbls.)
Cost of fuel per round voyage (at sea only) .....	\$7,350.00	2,756.00
Lubricating oil per round voyage of 6,800 miles .....	250 gals.	750 gals.
Engineers, firemen, cleaners, oilers, etc. ....	13	12
Single or twin screw .....	Single	Twin
Type of engine .....	Geared-Turbine	4-cycle single-acting Diesel
Average fuel consumption at sea, including auxiliaries. ....	1.00 lbs. per i. h. p. hr.	0.32 lbs. per i. h. p. hr.
Average daily consumption of main engine at sea .....		8 1/4 tons (63 bbls.)
Average daily consumption of donkey-boiler at sea .....		3/4 ton (6 bbls.)
Daily port consumption .....	10 tons (70 lbs.)	2 tons (14 bbls.)
Cost of fuel per barrel .....	\$1.50	\$1.75

Mr. Ferris gives the bunker capacity of the steamer as 680 tons. But as this ship would spend 24 to 25 days at sea for a round voyage from New York-London-New York (approximately 6,800 sea miles) the author of the article fails to see how less than 700 tons can be used even without allowing for four or five days consumption in port when at London. However, the writer considers that no sensible shipowner would send a steamer of this size and power on a 25-day voyage without at least 800 tons (5,600 barrels) in her bunkers, which would give her a margin for a possible two extra days at sea, and some oil for port use. Now to obtain the same margin the motorship would only require a total of 255 tons (1785 barrels) or about 30 more tons than that actually used. Hence, we had better estimate the actual bunker-fuel capacities as 800 tons and 255 tons respectively, instead of the figures given in the table. But we will take the smaller weights for the purpose of estimating the operating costs. To the various remarks in this paragraph Mr. Ferris does not agree.

In figuring out the fuel cost we have taken a price of \$1.50 per barrel for the fuel used by the steamer, and \$1.75 per barrel for the better grade used by the motorship, as a basis, so that the comparison is quite fair. At sea, the donkey boiler of the motorship is oil-fired at night only, but during the day the exhaust gases of the main engines used. In port the donkey boiler is oil-fired.

It will be seen that the cost of the crew work out about even, but that the lubricating oil bill of the motorship is much higher which the absence of standby charges in port and lower fuel consumption in port will even up, as the steamer is burdened with a large fuel bill when in port, this being \$105 per day compared with \$25 for the motorship.

Now, the fuel bills at sea of the steamer and of the motorship work out at \$7,350 and \$2,756 per round voyage respectively. That is to say, an economy of \$4,594 in favor of the Diesel driven craft. Nine round voyages per year mean an annual fuel bill reduction of \$41,346.

As before mentioned the greater port consumption of fuel will balance the greater amount of lubricating oil used by the motorship.

By checking up the dimensions it will be realized that the Diesel ship is a much smaller vessel, yet she carries the same amount of cargo in her

holds. Because she is of smaller size she is cheaper to construct, especially as the engines installed in the motorship can be obtained today at prices no higher than the price of steam machinery—in fact some are cheaper than geared turbines and boilers. The motorship being smaller should have lower maintenance, insurance and depreciation charges.

But this is not the best method of obtaining the greatest advantage of the Diesel engine. The best plan is to build the hull to exactly the same overall dimensions as the steamer that we already have quoted in this article, so that the first cost

will be approximately the same. Then the motorship will have a greater cargo-carrying capacity of 705 tons, which is made up of the following weight savings (fuel 445 tons, machinery 190 tons, boiler water 70 tons), but her fuel bill will still be at least one-third of that of the steamship. On this consumption a little calculation on the basis of 9 one-way voyages loaded, and 9 one-way voyages in ballast per annum will show that the gain (with freightage on oil cargo at \$12 per ton) will mean \$76,140. If the freight rates are higher or lower the gain in favor of the Diesel vessel will be in proportion.

Seeing that the dimensions of such a motorship will be larger than that which we have taken for comparison purposes, she will need a little more horsepower to drive her at eleven and a half knots, and her consumption will increase to 9 1/2 tons (65 1/2 barrels) per diem, and this will give her an annual fuel bill (at sea) of \$25,790 compared with \$66,150 for the steamer, which still leaves a difference of \$30,340 in the favor of the Diesel tanker.

Hence the total Diesel motorship gains are:

Fuel bill saving effected..\$ 40,360.00  
Increased cargo earnings.. 76,140.00

Total .....\$116,500.00 per annum

Even if some breakdowns to the machinery occurred and repairs have to be made, there will be plenty of profit left for the shipowner. Here let it be said that the author has authentic records supplied by the owners where half-a-dozen Diesel motorships each have had less than two thousand dollars spent in repairs to the machinery during one, two and three years' services. In one case a Diesel motorship of about 7,000 tons has been running in the Transatlantic service for nearly a year, and not a penny has been spent on alterations or repairs to the main engines. Nor has she been laid up a single day with machinery out of order. These records are available to shipowners interested.

### REPEAT ORDER FOR SUMNER ENGINES.

The H. W. Sumner Co., the designers of the Sumner engine, have received an order from Gaston Williams and Wigmore for a twin set of 350 b. h. p. Sumner oil engines, which will be identical with the engines installed in the auxiliary motor schooner "Santino," now on her maiden voyage to New York.

# My Experience With Ocean-Going Diesel Motorships

By J. E. COLE, Chief Engineer of the M. S. "Sebastian;" M. S. "Abelia," etc.

(Continuation of Article in March Issue of Motorship)

SOME builders design their cooling arrangements so that the cylinder jackets and pistons are always kept at a fairly warm temperature, the idea I presume being to reduce the strain set up in the castings by the unequal temperatures between the cylinders, walls and the jackets. On one engine I was with on which the cooling system was designed as above a peculiar experience was the result. The engine ran well enough in water of moderate temperature, but we happened to get into pretty warm water, and the jackets were giving off a fairly good heat. Then one of the engines developed a knock. The motor was stopped and examined but everything appeared to be in order. Another start was made and after running a short while the knock came on again. On examination of the engine again the guide shoe was found to stick in the guide when the engine was on the bottom center.

The first thoughts were that the piston rod was bent, as the engine had been running for some time and nothing had been done to guides in the way of readjustment. The piston rod was found to be all right. The guide bars were then loosened a little to give the guide shoe freedom. After running for a while one of the other engines started to knock in the same manner. This guide bar was also loosened a little to take the knock off. At the finish the remaining engine developed this knock and the guide bars had to be loosened on both motors, as she was a twin-screw job. All this was caused by the expansion of the cylinders, the cooling water not being sufficient, and the columns opening out at the top, by the extra expansion of the cylinders threw the cylinders slightly out of line, causing the guide shoe to stick when the engine was on the bottom center.

Steam engineers will perhaps hardly credit this, as more expansion takes place with a steam cylinder between the columns than with a Diesel engine. If the steam engine guides are run as fine as it is necessary to run them on a Diesel engine, the engineer of the steam job will soon find that he has a hot guide. From my point of view there cannot be too good a circulation of cooling water. If there is plenty of circulation the metal does not have a chance to get heated

and there is less likelihood of scale formation.

With the two-cycle engine, where the cooling water is carried through the cross-head pins for the piston cooling is another example of the necessity for a good circulation of water. In the first place the pressure on the cross-head bearings is enormous, and if one bearing happens to get a little more weight than usual, a hot bearing is the result. Taking the two bearings A and B. The cooling water enters the pin at bearing A and after going through the piston passes out through the pin at bearing B. The water is hot, the pin gets heated and the bearing is also heated, causing a little more wear on bearing B due to the expansion of the metal. This may run at a steady temperature for a few days. Then as often happens, the piston cooling gets sluggish for some reason or another with a good rise in temperature at bearing B and also a little more wear. The piston cooling gets to normal again and bearing A gets hot due to the wear that has taken place on bearing B.

In another two-cycle engine I was in charge of we used to always get hot hearings as above if the piston-cooling circulation got sluggish. Then there is always a certain amount of leakage from the glands of the piston-cooling system, which is bound to take place, and when this leakage falls on the running parts of the machine, wear of bearings is the result, it may be very gradual, depending of course on the amount of leakage taking place. All water cooling connections should be kept outside of the engine casing, so that there is no possibility of the water getting at the running parts of the engine.

Another thing that does not improve bearings is the black carbonized lubricating-oil which falls from the cylinders (or into the scavenging-chamber if of the stepped-piston type of two-cycle engine), although trays of some form or another are generally fitted under the cylinders to prevent this getting amongst the lubricating oil. If there should be any leakage from these trays on to the engines a wear will be noticeable in a very short time and if there should be salt water in this mixture, it is almost as bad as running with emery powder in the oil, the wear is so heavy.

One of the first questions generally asked is how do the bearings run, as some people have got the idea that with a motor it is always a case of hot bearings and cracked cylinders. There have been motors that way. I have been with them myself. I have seen the lubricating oil filters choked up with small flakes of white metal and cleaned once an hour at that, and with a two-cycle engine also seen the same bearings wear down a quarter of an inch in five days, and the

engines stopped once or twice a watch, day after day.

But that is a thing of the past. With the modern four-cycle Diesel engine a hot bearing is no more frequent than with a steam engine. With the present four-cycle Diesel-engined ship I am with we have now done thirty-five thousand nautical miles, and the crank-shaft shows a wear down of less than 1-128th of an inch, which compares very favorably with any steam job, and never a hot bearing, cracked cylinder-heads, cracked cylinders or cracked pistons. I will not say that we do not get a few minor troubles, but then one has to consider that motors are yet in their infancy.

With the two-cycle motor, bearings do not run quite so sweetly as the case above. Owing to the continual pressure on the bearings it is the difficulty of getting the lubricant at the right spot. The oil instead of being carried round by the shaft, is wiped off, due to the pressure of the shaft on the bearings and with gravity lubrication, the shaft will feel quite dry as it leaves the bearing considering the amount of oil that is generally used.

To engineers who have not had motor experience the following may give them some idea of the pressure on the main bearings of a two cycle engine. The journals of the shaft had small flats cut on it, the length of these flats being shorter than the length of the bearing itself, to prevent the oil from escaping at the ends of the bearings. In the bottom of the bearing itself a recess was made to collect the oil, the idea being to form a bath, so that the shaft would always have oil at the under side. To this bath a connection was made by a spigot flange and a small pipe, with a cock attached so that the oil and sediment could be drained off at intervals and so prevent any accumulation of foreign matter. The flats on the shaft were for carrying round the oil so that there would not be any doubt of the bearing getting oil. After the engine had been running for a while, the bearings began to give trouble, and it was found that the joints at the spigot had blown out, allowing the oil to escape from the bottom of the bearing. These spigot flanges were very strong and were secured by two 1/2-inch studs. These were rejointed again, and the engine had not run long when the heating of the bearings again took place, the joints having blown out again. This was due to the flats on the shaft which was really acting as a pump, the pressure of the oil being so great, that the joints would not hold against the pressure at the bottom of the bearing.

(To be Continued.)



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### AUTOMOBILE ENGINES IN WORK BOATS.

The practicability of using a light type of high-speed motor in vessels of considerable tonnage has been amply demonstrated on the Atlantic Coast where numerous successful installations of this character are to be found especially in auxiliary yachts. In most cases, however, a reduction gear has been introduced on a ratio of two to one to obtain a better propeller efficiency, and the object of installing an engine of this type has in the past been more for the purpose of saving weight and space.

Today we hear of numerous marine high-speed installations for commercial use. The latest of these on the west coast being the two ferry boats designed by Lee & Brinton for the Port Commissioners of Seattle, and which will be used in service on Lake Washington. These vessels are 65x15 and each to be equipped with a six-cylinder 6x6 Van Blerk developing 120 b. h. p. at 1,000 r. p. m.; a reduction gear of two to one will be used, giving a propeller speed of 500 r. p. m.

For years past we have become accustomed to hearing of automobile engines used in light displacement pleasure boats and their success has depended entirely upon the type of motor, together with necessary alterations, especially if for salt water use.

The practicability of using these engines extensively for work boat purposes, without a reduction gear, has been exploited on the Pacific Coast to a considerable extent and with the assistance of L. E. Coolidge, propeller expert, the firm of George W. Miller & Co. of Seattle has obtained many splendid results.

First let it be clearly understood that there are only a limited number of makes of automobile motors which are suitable for marine purposes, and of course each and all must be equipped with a thrust.

A used high-grade 50 b. h. p. six-cylinder water-cooled four-cycle engine of the automobile type fitted with force feed lubrication and a carburetor which will vaporize distillate can be purchased at a figure below \$200 which comes within the means of the breadwinner who could not afford a new marine engine of half the power, especially of the heavy-duty type.

The successful operation of such an engine in a work boat with a direct drive will depend upon the main bearings and other wearing surfaces, and also the propeller used.

As the horsepower can only be obtained at high speeds, the propeller will have to be large in diameter and slow in pitch, the reverse proportions giving too great a percentage of slip.

For fishing purposes, say salmon trolling, perhaps a transmission gear would be of advantage as with the low gear in use and the engine throttled, a nice trolling speed could be obtained without fear of losing fish and tackle if six or eight strikes were made at the one time, and further, there would be less chance of stalling the engine.

Care, however, would have to be exercised when making a landing as the reverse would be about four to one of engine to propeller.

That these engines do stand up to hard usage in work boats is proved by the repeat orders received by Geo. W. Miller & Co from Alaska and elsewhere, and further by the large number annually sold for marine use around Puget Sound.

### NORTH BEACH BOAT BUILDERS.

Beviacqua & Castagnola, the well known fish-boat builders at Fishermen's Wharf, San Francisco, are laying the keel for a gas powered fish boat for the San Diego Marine Construction Co. The boat will be 55 feet in length, 13 feet beam and 6 feet, 6 inches in depth. She will be constructed of Douglas fir with a bent oak frame. There is to be a 15-foot cabin forward with berths for four men, and a 10-foot cabin and pilot house aft. Amidship is a hatch covering a large fish box. She will be equipped with a 60 h. p. Union gas engine. The same company is building a few salmon boats for the fishermen of Monterey. They recently completed six 28-foot salmon boats for Monterey. The boats now building will be powered by 8 h. p. Hicks gas engines.

### LARGE NEW FLEET OF POWER FISH BOATS.

Babare Bros. of Old Town, Tacoma, will eclipse all previous records by turning out over 70 power fish boats for the season of 1917. In the aggregate the value of this fleet will total around \$700,000. The last boat is expected to be in commission by May 31st.

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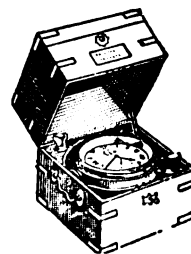
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**SHOULD MARINE OIL ENGINES HAVE  
CROSSHEADS?**

To the Editor, Motorship:

Sir—Many of those who read the description of the Sumner oil engine in the April issue of Motorship may not know that with one exception—namely the Bolnes motor—it is the only surface-ignition type of oil-engine to be constructed with crossheads and guides, this including both domestic and foreign designs. At least, this is so far as I can trace. The situation in the Diesel-engine industry is somewhat different, because, while most of the European marine Diesel-engines are designed built with crossheads and guides and operate at a slow speed, almost all of the American marine Diesel engines are constructed without crossheads and guides, and are of a lighter, higher speed, class.

Consequently the non-technical shipowner, who naturally leans towards the crossheads and guide design, is somewhat at a loss to know if they really are advisable with internal-combustion-engines.

The opinion of a well-known British builder of Diesel engines of both the trunk-piston crossheads and guides type may be worth paying heed to. I refer to Mr. Day of Mirrlees Bickerton and Day, who voiced his experiences to Diesel Engine Users Association recently. Mr. Day voiced the advantages and disadvantages of both types which I have listed as follows:

**Disadvantages of the Crosshead Construction.**

1. Extra cost.
2. Additional height.
3. Reciprocating weights heavier.

**Advantages of the Crosshead Construction.**

1. Greatly reduced risk of pistons seizing.
2. Pistons need not be so close a fit.
3. Transverse stresses due to connection-rod angularity taken by crosshead and not on the piston.
4. Greatly reduced risk of pistons cracking, as better support can be given to the center of piston which is exposed to greatest heat and maximum stress.
5. Less trouble with connecting-rod bearings as it is in a position quite away from the heat of the piston.
6. Cover can be fitted between the cylinder and crank-chamber, preventing dirty oil and carbon entering crank-chamber.
7. Lower lubricating oil consumption, due to reason No. 6, the oil retaining its condition longer; also because oil is not splashed on the cylinder walls by the connecting-rod and thus lost.
8. Pistons need not be made so thick and heavy.

**Disadvantages in Favor of the Trunk Piston.**

1. Pistons must be made thick and heavy because they are liable to distortion and cracking if the thickness and weight be reduced beyond certain limits.
2. Piston seizing is caused by distortion of the pistons, due to irregular section, or to the expansion of the piston pins.

It would be very interesting to have the opinions of American manufacturers on this subject and I'm sure that other shipowners, as well as myself would like to have matters made clear on this point. At present some oil engine builders build their motors with trunk pistons and crossheads, some with short pistons and crossheads, others with trunk-pistons and no crossheads. It is hardly feasible that all three designs can be correct for marine work, so it will be well to have an elucidation on this subject. Will domestic oil-engine builders be bold enough to make public their reasons for the adoption, or dispensing with, crossheads as the case may be?

Yours very truly,

SHIPOWNER.

**TRIAL OF THE "ANGEL"**

The converted schooner "Angel," which is at the dock of the Union Gas Engine Co., Oakland, having a 225 h. p. 4-cylinder Union gas engine installed, will have her trial trip this month, after which she will proceed south for duty in the Mexican coast trade. She is owned by the Merchants' Navigation Co., of Los Angeles.

**"S. I. ALLARD" INSTALLATION.**

The aux. motorship "S. I. Allard," owned by the Chas. R. McCormick Co., a sister ship to the "City of Portland," which has just completed a trip to Australia and return, is in San Francisco having her power installed. She is being equipped with twin 320 b. h. p. Bolinder oil engines. The installation is being made by the McCormick company.

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